WILTRON

RF ANALYZER
MODEL 640
OPERATION AND MAINTENANCE
MANUAL

WILTRON

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4-640-OMM
R1 through R8
(Serial Nos. 809000 and below)

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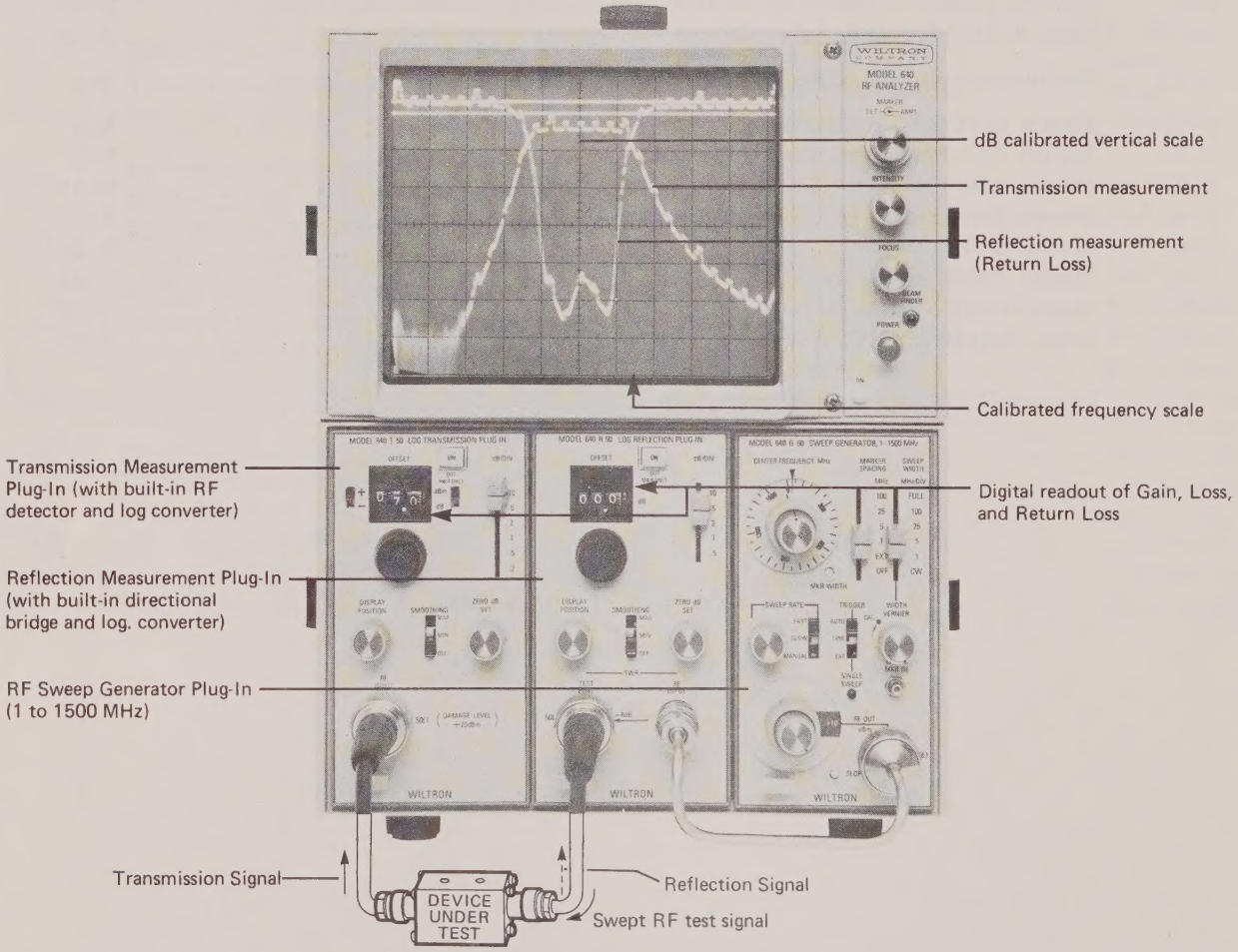

dB calibrated vertical scale
Transmission measurement
Reflection measurement (Return Loss)
Calibrated frequency scale
Transmission Measurement Plug-In (with built-in RF detector and log converter)
Reflection Measurement Plug-In (with built-in directional bridge and log. converter)
RF Sweep Generator Plug-In (1 to 1500 MHz)
Digital readout of Gain, Loss, and Return Loss
Transmission Signal
Reflection Signal
Swept RF test signal
DEVICE UNDER TEST
WILTRON
MODEL 640
RF ANALYZER

Figure 1-1. WILTRON Model 640 RF Analyzer

SECTION I
GENERAL DESCRIPTION

1-1 INTRODUCTION

This manual contains all information necessary to operate and maintain the WILTRON Model 640 RF Analyzer. A general description of the system, its plug-in units, external accessories and specifications is given in this section. Descriptions of all controls, connectors and indicators, plus detailed operating instructions, are given in Section II. Circuit theory, for the Main Frame and for each plug-in, is presented in Section III. Performance verification and troubleshooting information is given in Section IV. Parts lists and schematics can be found in Sections V and VI respectively.

1-2 SYSTEM DESCRIPTION

The WILTRON Model 640 RF Analyzer, shown in Figure 1-1, is a precision Network Analyzer capable of magnitude (scalar) measurement of transmission (gain or loss) and reflection (return loss or SWR) over a swept frequency range from 1 to 1500 MHz. A special feature of the instrument is its ability to make simultaneous transmission and reflection measurements. It is available in both 50-ohm and 75-ohm versions.

The Main Frame holds 3 plug-in units, and also supplies DC power to both the plug-ins and the front panel CRT display. The large 8 x 10 graticule has 1/2-inch divisions, and is calibrated vertically in dB (gain or loss) and horizontally in MHz (swept frequency). A rear panel BNC connector allows connection of an X-Y Recorder for permanent recordings of the measurement parameters.

1-3 PLUG-IN UNITS

The 1-1500 MHz RF Sweep Generator (Model 640G) covers the entire range in one continuous sweep. High signal purity permits accurate measurements. Harmonics are 30 dB down from 5-1500 MHz, and spurious signals are 45 dB below the fundamental at full rated output (10mW). Both sweep width and center frequency are selectable at the front panel. Available widths are 1, 5, 25 or 100 MHz per division, and CW is also available. In addition, crystal markers are provided at 1, 5, 25 and 100 MHz. Marker accuracy is 0.01%, and markers are graduated in height for easy identification. Output power can be adjusted in 10 dB steps from -70 dBm to +10 dBm, and is continuously variable over a 10 dB range. The Log. Transmission Plug-In (Model 640T) provides scalar measurement over a 70 dB range. The sensitivity is selectable at 10, 5, 2, 1, 0.5 and 0.2 dB per division. Noise level is typically -60 dBm. Typical drift accuracy is ±0.02 dB/°C. A calibrated digital offset is provided. The plug-in unit can also be used as a power meter, measuring absolute power from -55 to +10 dBm.

The Log. Reflection Plug-In (Model 640R) is capable of measuring the match or return loss of the device under test down to -54 dB. Sensitivity is selectable at 10, 5, 2, 1, and 0.5 dB per division, and a digital offset is provided. High accuracy is assured by a built-in directional bridge having a directivity exceeding 40 dB over the full frequency range. The minimum detectable return loss signal is -49 dBm.

In instances where it is not feasible to connect the test device directly to the Model 640 RF Analyzer, the Model 640E Log. Amplifier Plug-In and an external directional bridge and RF detector may be used (the configuration is described in paragraph 1-4). This amplifier is of

particular advantage when a large number of different test connectors are required. The scalar measurement range and accuracy are the same as described for the Model 640T and 640R Plug-In units.

If a vertical presentation in linear rather than logarithmic units is required, the Model 640L Plug-In should be used. The linear plug-in gives sensitivities as high as 1 mV/division. The offset is calibrated in mV from 1 to 1,000. As with the Model 640E Log. Amplifier Plug-In, an external RF detector and/or directional bridge is required. Figure 1-2 shows all four plug-in units.

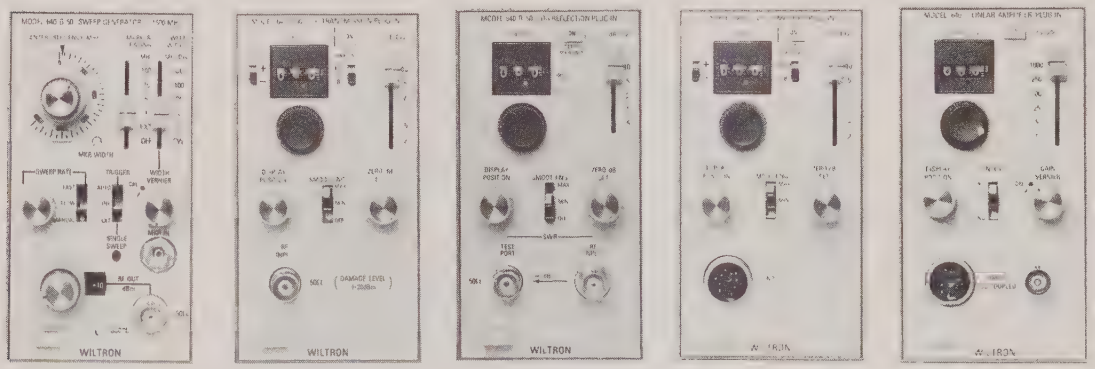


Figure 1-2. Plug-In Units for the Model 640 RF Analyzer

1-4 TYPICAL MEASUREMENT CONFIGURATIONS

Figure 1-3 shows typical measurement setups for simultaneous transmission and reflection measurements. The configuration shown in (A) uses the Model 640G (Sweep Generator), 640R (Reflection), and 640T (Transmission) Plug-Ins. Both transmission and reflection measurements are simultaneously displayed on the CRT and independently controlled. This configuration is ideally suited to testing components (such as bandpass filters) which can be directly connected to the Model 640 RF Analyzer by short low-loss cables.

In instances where it is not feasible to connect the test device directly to the Model 640 Analyzer, the configuration shown in Figure 1-3(B) is used. It consists of the Model 640G Sweep Generator, two Model 640E Log. Amplifiers, a Model 6 Series SWR Autotester, and a Model 7 Series RF Detector. The device under test is connected between the SWR Autotester and the RF detector. If simultaneous transmission and reflection measurements are not required, only one Model 640E Log. Amplifier plug-in is needed.

Figure 1-4(A) shows a test configuration for precision SWR and insertion gain/loss measurements. The system differs from that shown in Figure 1-3(B) in that the SWR Autotester has been replaced by a Model 66G Precision SWR Bridge, plus an additional RF detector. The directivity of the bridge is greater than 60 dB, permitting very low reflection signals to be measured accurately.

Production testing often uses a reference standard for comparison with the device under test. A typical test configuration is shown in Figure 1-4(B), and is convenient for high-volume yet accurate testing. A signal divider splits the output of the Model 640G Sweeper into two branches for comparison. The device under test is in one branch, the reference standard in the other. A direct comparison reading is given on the CRT display.

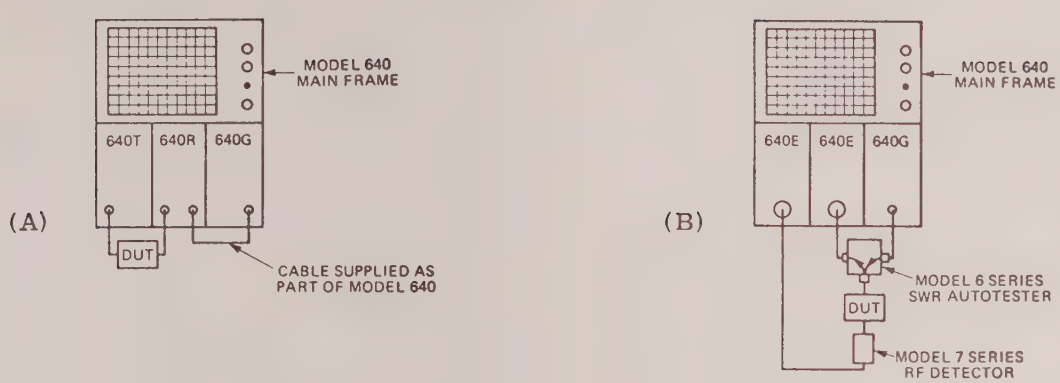


Figure 1-3. Typical Configurations for Insertion Gain/Loss

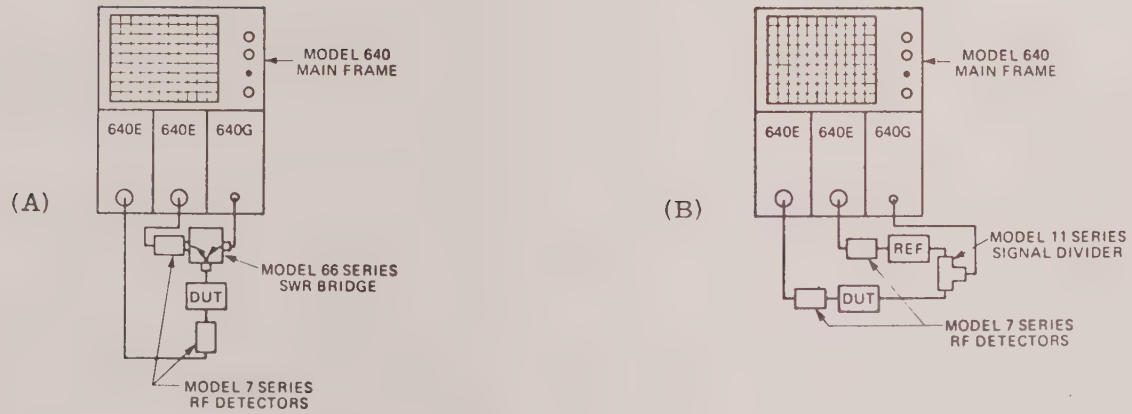


Figure 1-4. Precision and Comparison Test Configurations

1-5 APPLICATIONS

The convenience, sensitivity, and accuracy of the Model 640 RF Analyzer make it an ideal choice for a wide variety of measurements. Some of these are described in the following paragraphs.

1-5.1 S-Parameter Magnitude Measurements

The Model 640 can directly produce S-parameter magnitude information. First, the reflection S11 from the input port of the test device and the transmission S21 to the output port are read directly in dB. Then the two connections from the Model 640 to the test device are reversed, and the reflection S22 from the output port and the transmission S12 from output to input are similarly measured.

1-5.2 TV Converter Gain/Loss Measurements

When measuring TV front ends with some broad-band measurement systems, a portion of the local oscillator signal is present, and this causes trouble because it adds to the desired IF signal. This causes the detector output to be erroneously large. Not only is the conversion measurement inaccurate, the shape of the IF response curve appears to change with level (if the detector law is not uniform), and the scope display moves disturbingly if adjustments are made to the LO signal.

In the Model 640 system, the LO signal is not derived from the Model 640G Sweep Generator, so the system excludes it from the display. Converter adjustments thus do not cause any large vertical display shifting (any shifting on the Model 640 display will typically be small and brief).

1-5.3 TV Tuner Image Rejection Measurements

TV tuners for some markets require adjustment for maximum image-frequency rejection. The tests require that the image response be sensed down to levels 75 dB below the desired IF response. Although the required sensitivity is beyond the capabilities of most broad-band instruments, such measurements are easily made with the Model 640.

First, the tuner conversion gain is measured. In a typical image-rejection measurement, the input level must be no higher than -30 dBm. Assuming the conversion gain is typically 20 dB, the IF output level will be -10 dBm, and will be recorded. It should be noted that the noise level of the Model 640 is only 45 dB below this level. To read a signal 75 dB down, the RF input signal to the tuner is increased some 30 dB (to about 0 dBm), using the calibrated Model 640 output attenuator. The increased input level causes the TV converter to limit at the IF frequency, so the response at the image frequency is typically undistorted.

1-5.4 TV Repeater System Measurements

The small size and completeness of the Model 640 as a measuring system make it a natural choice for testing TV repeater systems, especially those in remote locations. A light-weight carrying case (WILTRON Part Number 2000-21) is available for the portable model.

1-5.5 Probing and Signal Tracing

The Model 640 also lends itself to signal tracing and fault location techniques, since it provides both a test signal and a sensitive signal-sensing system. For such use, it is desirable that the 50-ohm input impedance of the Model 640 be increased by the use of probes such as the HP 1002A, or Tektronix P6056 (10X) or P6057 (100X).

1-5.6 Low-Level Amplifier/Mixer Impedance Match Measurements

In a typical case, a signal may be applied to a receiver, amplifier, or mixer at a level of -25 dBm from the Model 640R TEST PORT. The reflection signal is

attenuated some 6 db by the directional SWR Autotester inside the Model 640R. This means that reflections as small as 24 dB (1.13 SWR) can readily be measured (the Model 640 noise level is typically -60 dBm).

For devices accepting applied signals at levels higher than -25 dBm, SWR's below 1.06 can be measured. The limit is set by the 40 dB directivity of the SWR Autotester in the Model 640R Reflection Plug-In.

1-5.7 Cable Testing

The Model 640 is unusually convenient for measuring wideband coaxial cable, since it makes both swept-band reflection and transmission measurements. Coaxial cables are typically tested on the reel by reflection-type measurements. However, since the periodic deformation occurs in a long cable, this means that not only will the reflection be reduced by cable losses, but different values of reflection may be obtained for different signal directions. The ability of the Model 640 to offset (and thus expand) the display sensitivity to as high as 0.2 dB per division is decidedly valuable in making transmission checks for cable defects.

1-5.8 Filter Skirt Depth

The high sensitivity and low spurious output of the Model 640 RF generator permits measuring filter skirts to lower levels than any previous broad-band system. The spurious output of the generator is 50 dB down; the sensitivity is -60 dBm.

In measuring the skirt depth of filters, the filter bandwidth determines the depth to which the skirt can be measured. This occurs because the filter passband passes noise, which is detected by the broad-band detector. So the noise power being passed determines the measurement limit, if that noise power is greater than the -60 dBm sensitivity of the Model 640 system.

The following table gives some representative values of measureable skirt depth for various filter bandwidths, with the Model 640 system.

Filter Passband (in MHz)	Minimum Measureable Skirt Depth
1500	50 dB
500	55 dB
100	62 dB
20	>65 dB

1-6 ACCESSORIES AND EXTERNAL COMPONENTS

Table 1-1 lists the complete set of accessories and external components available for the Model 640 RF Analyzer, and identifies those components needed for different system configurations. Figure 1-5 illustrates some selected examples of components.

Table 1-1. Accessories and External Components

EXTERNAL COMPONENTS

RF Detectors Exclusively for Model 640

Model	Input Connector	Input Impedance (Ω)
7B50	BNC Male	50
7N50	Type N Male	50
7B75	BNC Male	75
7N75	Type N Male	75

SWR Autotesters Exclusively for Model 640

Model	Test Port Connector	Input Impedance (Ω)	Directivity (dB)
6B50	BNC Male	50	40
6BF50	BNC Female	50	40
6N50	Type N Male	50	40
6NF50	Type N Female	50	40
6B75	BNC Male	75	40
6BF75	BNC Female	75	40
6N75	Type N Male	75	40
6NF75	Type N Female	75	40

Matching Pads

Model	50Ω Connector	75Ω Connector	Max. SWR
12B50/75	BNC Male	BNC Female	1.25
12N50/75	Type N Male	Type N Female	1.25
Insertion Loss: 6 dB nominal.			

Signal Dividers

Model	Connectors	Input Impedance (Ω)	Max. SWR
11B50	BNC Female	50	1.25
11N50	Type N Female	50	1.25
11B75	BNC Female	75	1.25
11N75	Type N Female	75	1.25

Low SWR RF Cables

Model	Both Connectors	Impedance (Ω)	Length Feet	Length (cm.)	Max. SWR
10B50-1	BNC Male	50	1	(30)	1.1
10B50-2	BNC Male	50	2	(60)	1.1
10B50-3	BNC Male	50	3	(90)	1.1
10N50-1	Type N Male	50	1	(30)	1.1
10N50-2	Type N Male	50	2	(60)	1.1
10N50-3	Type N Male	50	3	(90)	1.1
10B75-1	BNC Male	75	1	(30)	1.13
10B75-2	BNC Male	75	2	(60)	1.13
10B75-3	BNC Male	75	3	(90)	1.13
10N75-1	Type N Male	75	1	(30)	1.13
10N75-2	Type N Male	75	2	(60)	1.13
10N75-3	Type N Male	75	3	(90)	1.13

OPTIONS AND ACCESSORIES

Optional Items

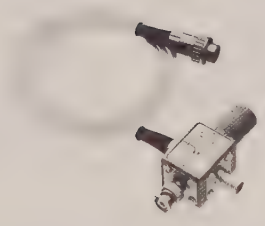
Blank Plug-In Panel, Model 640PI
Option 1: Rack Mounting
Option 2: Pen Lift Contacts
Option 3: Type N Female connectors
Option 4: Protective covers for 640 Main Frame, Front and Rear (cabinet model only)
P/N 2000-21 Fiberglass Carrying Case

Linear Plug-In Model 640L

For use in place of Model 640T, 640R, or 640E Plug-Ins for applications where a linear rather than logarithmic display is desired.

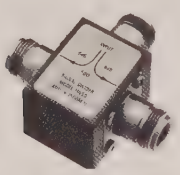
Service Accessories

640-ML-5282 Extender Cable for servicing Plug-Ins
Replacement Diode for Model 6 Series
Replacement Diode for Model 7 Series

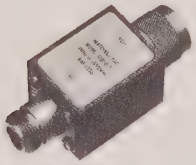


External SWR Autotester (Model 6B50) for use with 640 system when using 640E or 640L plug-ins. Type N and 75-ohm versions also available.

External RF Detector (Model 7B50) for use with 640 system when using 640E or 640L plug-ins. Type N and 75-ohm versions also available.



Signal Divider (Model 11N50) has been designed in versions to fit 50-ohm or 75-ohm systems with type BNC or N connectors.



Matching Pad (Model 12N50/75) to adapt 640 system 50-ohm output to 75 ohms. Type BNC version also available.

Low SWR Cables (Model 10B50-1) for use with 640 system are in 50- and 75-ohm types, in lengths from 1 to 3 feet (30 to 90 cm.) and with BNC or type N connectors.

Figure 1-5. External Components for the Model 640 RF Analyzer

1-7 SPECIFICATIONS

Table 1-2 lists the major operating and performance specifications for the WILTRON Model 640 RF Analyzer system. Dimensions, power requirements, and weight are described below.

POWER REQUIREMENTS: 100, 110, 120, 200, 220, or 240 VAC ±10%, internal jumper selected. 48 to 440 Hz.

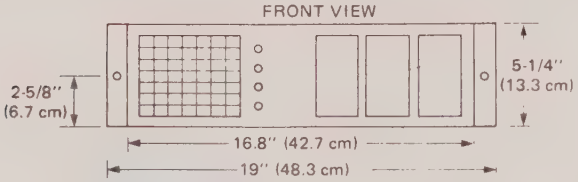
WEIGHT: Approx. 30 lbs. (13.7 kg.), (including 3 plug-ins).

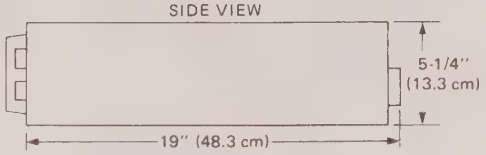
Shipping Weight: Approx. 40 lbs. (18 kg.)

DIMENSIONS

Cabinet Model Main Frame: 12" H x 8-1/2" W x 20-1/2" D (30.5 cm. H x 21.6 cm. W x 52 cm. D)

Rack Mounting Dimensions:





1-8 POWER VOLTAGE SELECTION

The power transformer in the Model 640 permits operation from 100V, 110V, 120V, 200V, 220V, and 240V sources, with power line frequencies from 48 to 440 Hz. Use the procedure on page 1-10 to obtain correct instrument operation from the line voltage available.

NOTE

This instrument is intended for operation from a single-phase, earth-referenced power source having one current-carrying conductor (the Neutral Conductor) near earth potential. Operation from power sources where both current-carrying conductors are live with respect to earth (such as phase-to-phase on a three-wire system) is not recommended, since only the Line Conductor has over-current (fuse) protection within the instrument.

Table 1-2. System Specifications

RF SWEEP GENERATOR SPECIFICATIONS

FREQUENCY RANGE: 1 MHz to 1500 MHz continuous coverage.

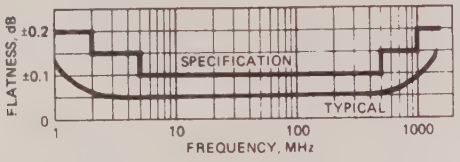
OUTPUT:

Power Level: Adjustable from +10 dBm to -70 dBm; seven 10 dB steps, plus vernier control with > 10 dB range.

Step Attenuator Accuracy:

Step	Absolute Accuracy	Incremental Accuracy
10 dB	±0.3 dB	±0.3 dB
20	±0.5 dB	±0.5 dB
30	±0.7 dB	±0.5 dB
40	±0.7 dB	±0.5 dB
50	±0.7 dB	±0.5 dB
60	±0.7 dB	±0.6 dB
70	±0.7 dB	±0.7 dB

Flatness (at 10 dBm):



Slope Adjust: Front panel control with ±2 dB min. adjustment range over full sweep width

Signal Purity:

Harmonics: > 30 dB below rated output 5-1500 MHz, 25 dB typical at 1 MHz.

Spurious: >45 dB below rated output, 50 dB typical

Residual AM: -60 dB in 1 kHz, -40 dB in 1500 MHz bandwidth at +10 dBm.

Residual FM, CW Mode: 7 kHz peak, max. in 28 kHz bandwidth

External AM: Rear BNC input connector. DC to 5 kHz min band width

External FM: Rear BNC input connector. DC to >50 kHz bandwidth (for dev.<5 MHz) 100mV/MHz sensitivity to ±10 V max input voltage.

RF Output Impedance:
Plug-In Model 640G50: 1.35 SWR typ.
Plug-In Model 640G75. 1.35 SWR typ.

RF Output Connector: BNC Female
Option 3: Type N Female

MARKERS:

Spacing: 1, 5, 25, and 100 MHz spacing selectable 0.01% frequency accuracy, 0.01% spacing accuracy with graduated amplitude

Width: Variable with front panel control over five to one ratio

EXTERNAL INPUT:

Frequency range: 10 MHz to 1500 MHz

Input level: -5 to +5 dBm for best results +13 dBm max

FREQUENCY CONTROLS:

Center Frequency: Sets center of sweep width or CW frequency output. Functions as a variable frequency marker when in the full sweep mode

Sweep Width: Selects full sweep (1-1500 MHz), calibrated sweep widths of 1, 5, 25 and 100 MHz per division, or CW frequency

Width Vernier: Allows continuous reduction of the 1, 5, 25 and 100 MHz per division sweep widths.

SWEEP RATE:

Fast range: adjustable from approx. 0.02 to 2 seconds

Slow range: adjustable from approx. 1 to 100 seconds.

Manual: continuous manual scan between frequency settings. The Horizontal Voltage output tracks this manual frequency control

TRIGGER MODE:

Auto: Sweep occurs automatically.

Line. Sweep automatically synchronized with the power line frequency.

External: Single Sweep is actuated by a front panel pushbutton or external TTL-compatible input on rear panel. Transition to low state or contact closure triggers sweep

TRANSMISSION MEASUREMENT SPECIFICATIONS

Detector Input Impedance: Plug-In Model 640T50: 50 ohms
Plug-In Model 640T75: 75 ohms

Dynamic Range: > 70 dB

Noise Level: -60 dBm typical

Offset: Calibrated in dB over > ±90 dB range

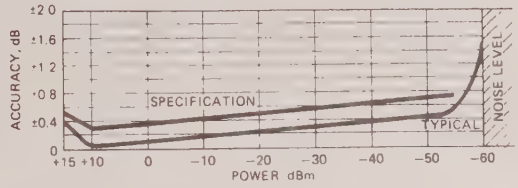
Display Sensitivities: 10, 5, 2, 1, 0.5, 0.2 dB per division

RF Input Connector: BNC Female

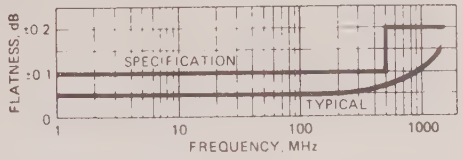
Option 3: Type N Female

Smoothing: selectable for noise reduction at low levels

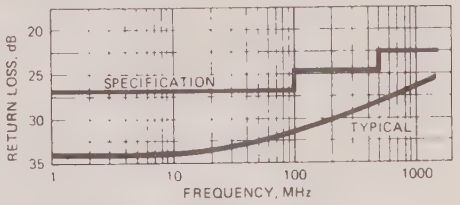
Accuracy: at 25°C, Typical Drift ±0.02 dB/°C to 0° or 50°C



Detector Flatness vs. Frequency:



Detector Return Loss vs. Frequency:



EXTERNAL DETECTORS:

The Model 7 Series meet the above specifications when used with the Model 640E Log Amplifier plug-in. The RF input connector is established by the model of the Detector selected

REFLECTION MEASUREMENT SPECIFICATIONS

Test Port Impedance:
Plug-In Model 640R50. 50 ohms
Plug-In Model 640R75. 75 ohms

Test Port Signal: +4 dBm or lower

Minimum Detectable Return Loss Signal: -49 dBm

Offset: Calibrated in dB over > ±90 dB range

Display Sensitivities: 10, 5, 2, 1, 0.5 dB Return Loss per division

Smoothing: selectable for noise reduction at low levels

Test Port Connector: BNC Female

Option 3: Type N Female

Directivity: 40 dB minimum

EXTERNAL SWR AUTOTESTERS:

The Model 6 Series SWR Autotesters meet the above specifications when used with the Model 640E Log Amplifier plug-in. The test port connector is established by the model of the SWR autotester selected.

LINEAR PLUG-IN SPECIFICATIONS

Maximum input: ±10V

Display Sensitivities: 1000, 250, 100, 25, 5, 1 mV/DIV , plus vernier with > 10:1 range

Offset: Calibrated in mV with 1000mV range

Bandwidth: > 10 kHz

Polarity: Selectable for positive or negative detectors

Input Connectors: Type BNC for general purpose input, and 5-pin connector for Model 6 and 7 Series External Components

Power Voltage Selection Procedure:

1. Disconnect the instrument from the power source.

2. Remove the bottom dust cover of the instrument to gain access to the Power Supply circuit board.

3. To convert from 120 Volts to 220 Volts nominal line voltage, or vice versa, remove the line-selector block from the square pin connectors (see Fig. 1-6) and replace it with the other block. Remove the line fuse from the fuse holder located on the rear panel of the display module and replace it with one having the correct rating. The unused line-selector block and line fuse can be stored on the Power Supply circuit board. Change the line-cord power plug to match the power source receptacle, or use an adapter.

NOTE

The 120-Volt block is color-coded brown, and connects the transformer primary windings in parallel. The 220-Volt block is color-coded red, and connects the primary windings in series.

4. To change regulating ranges, place the line-selector block on the desired set of square pins. Select a range which is centered about the average line voltage to which the instrument is to be connected (see Table 1-3).

5. Change the nominal line voltage information on the rear panel of the instrument. Use a non-abrasive eraser to remove the previous data, and mark in the new data with a pencil.

6. Replace the bottom dust cover and apply power to the instrument.

CAUTION

Damage to the instrument may result from incorrect placement of the line-selector block.

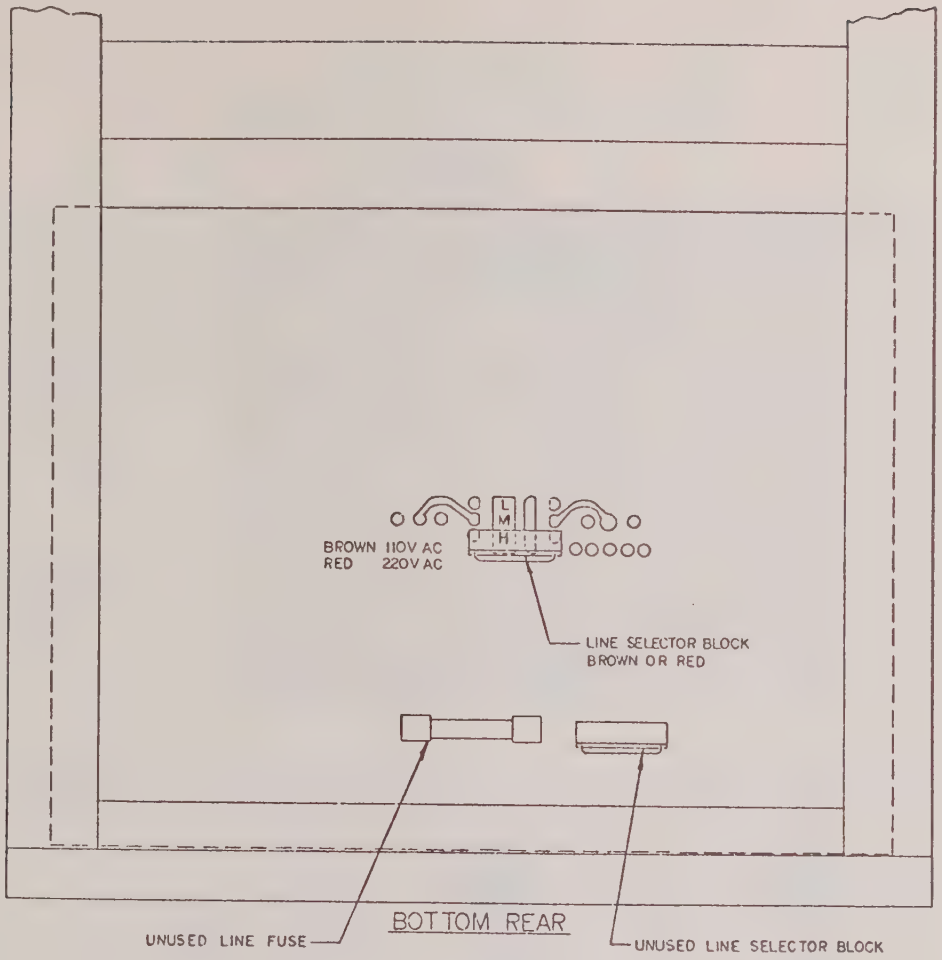


Figure 1-6. Location of Line-Selector Block on Power Supply Circuit Board

Table 1-3. Universal Transformer (S. N. BO 50000-up)

LINE SELECTOR BLOCK POSITION	REGULATING RANGES	
	120 VOLTS NOMINAL	220 VOLTS NOMINAL
L	90 VAC to 110 VAC	180 VAC to 220 VAC
M	99 VAC to 121 VAC	198 VAC to 242 VAC
H	108 VAC to 132 VAC	216 VAC to 264 VAC
Line Fuse Data	1.6A slow-blow	1A slow-blow

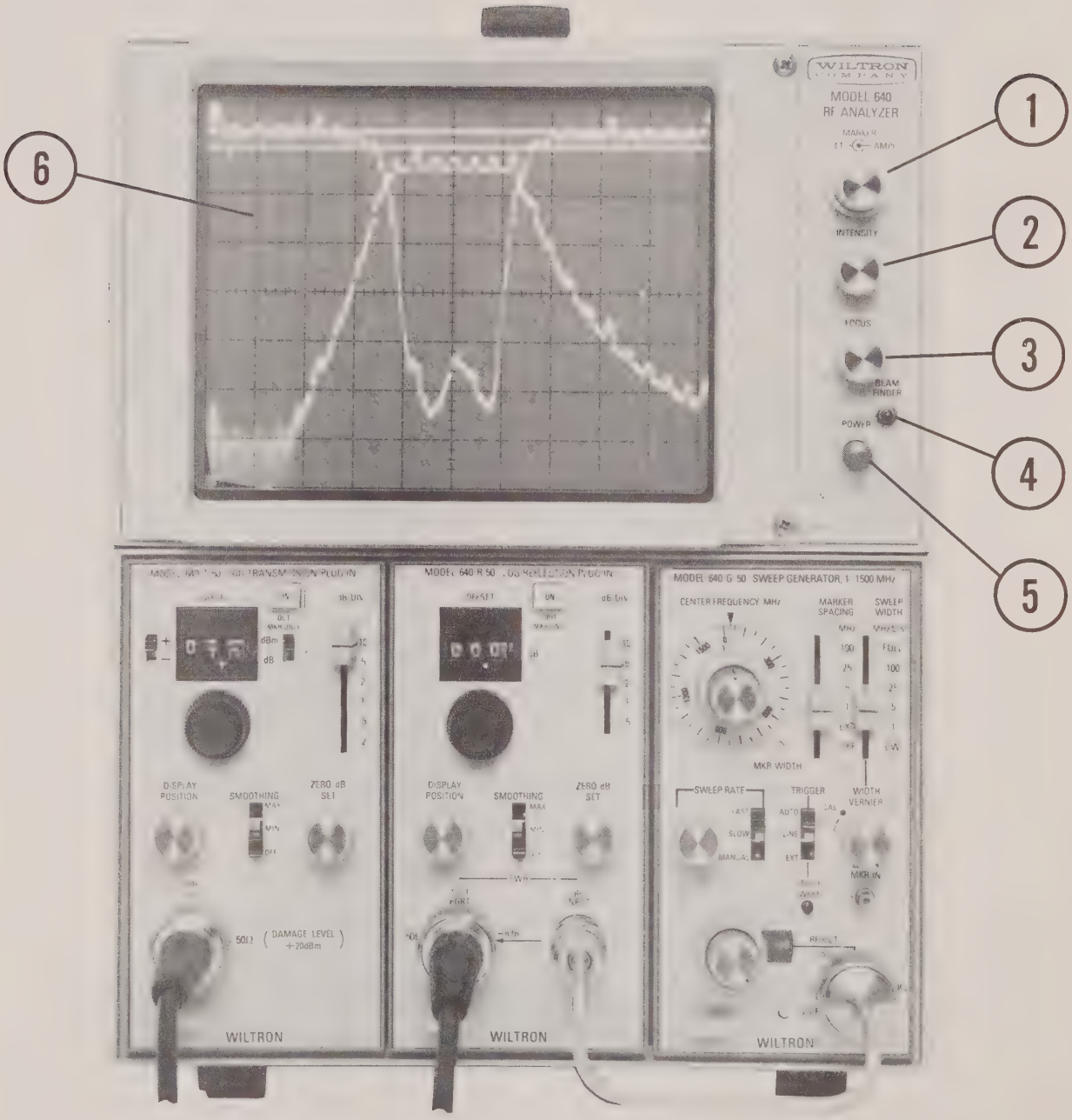


Figure 2-1. Front Panel, WILTRON Model 640 RF Analyzer

SECTION II

OPERATING INSTRUCTIONS

2-1 SCOPE

This section contains descriptions of all controls, connectors, and indicators and their functions. Included are detailed instructions for performing various types of measurements, as well as specific applications and operating hints. This section also contains a list of performance checks, which is used to ensure that all elements in the system are operating properly.

2-2 CONTROLS, INDICATORS AND CONNECTORS

2-2.1 Main Frame, Model 640 (See Fig. 2-1)

(1) MARKER - Outer TILT control adjusts the comb marker and the variable center frequency marker to tilt either to the left or to the right as desired for best visibility. The inner AMPLITUDE control adjusts the height of all markers.

(2) INTENSITY - Adjusts the intensity of the display trace.

(3) FOCUS - Adjusts the focus of the display trace.

(4) BEAM FINDER - Press to find out in which direction beam or retrace is off-screen. Use amplifier DISPLAY POSITION control to return retrace to screen. (If necessary, OFFSET or ZERO dB SET can be used to return main trace.)

(5) POWER - Pull switch out to turn on system power.

(6) CRT DISPLAY - Two measurements are displayed simultaneously on the large 8 x 10 graticule CRT screen with 1/2-inch divisions. The vertical display sensitivity is selectable in calibrated increments of 0.2 to 10 dB per division. Horizontal sensitivity is selectable from 1 to 100 MHz per division, with variable expansion on all but the FULL (0-1500 MHz) range. The return trace is not blanked, but provides a zero reference line for measurements.

2-2.2 Rear Panel Interface Connections (BNC Female Connectors)

HORIZONTAL: 0 to +10V output, which corresponds to 1V per division on the CRT display.

VERTICAL (both channels): -4 to +4V output proportional to the vertical trace on the CRT (1V per division).

EXT AM: Used to amplitude-modulate the RF signal by means of an external input. DC-coupled with a minimum 3 dB bandwidth of 5 kHz.

EXT FM: DC-coupled with a minimum 3 dB bandwidth of 50 kHz. Sensitivity approximately 10mV/MHz ±10V maximum input voltage. Can be used to externally sweep from 1-1500 MHz by applying a 0 to 15V ramp. An internal switch (S101) on the sweeper plug-in PC Assembly must be set to the FM position.

EXT TRIGGER: TTL-compatible input which triggers the sweep during a transition from a high to a low signal level. The sweep can also be triggered by a contact closure.

PEN LIFT (Option 2): Provides a contact closure during sweep to automatically drop the pen of an external X-Y recorder when in the slow sweep mode.

2-2.3 Sweep Generator Plug-In, Model 640G (See Fig. 2-2)

(1) CENTER FREQUENCY, MHz - This control works in conjunction with the SWEEP WIDTH, MHz/DIV (switch (9)) control. In any of the calibrated modes, the center frequency control sets the center of the band being swept. In the FULL sweep width mode, this control sets only the position of the variable marker. In the CW mode, this same control sets the frequency of the RF output. If should be noted that for very low-level measurements (i.e. below 35 dBm), one of the swept frequency modes should be used.

(2) MKR WIDTH (Marker Width)* - Sets the width of the comb markers for convenient viewing. (The wider marker widths are generally more convenient when wide sweep widths are selected.) In general, a 5:1 ratio is provided.

(3) SWEEP RATE - Slide switch selects FAST, SLOW or MANUAL sweep rate for both RF output and for the CRT display beam.

(4) SWEEP RATE VERNIER - Works as follows for each of the sweep rate settings:

FAST: Varies the sweep rate from approximately 0.02 to 2 seconds for full sweep.

SLOW: Varies the sweep rate from approximately 1 to 100 seconds for full sweep.

MANUAL: Provides continuous manual adjustment of frequency between the end frequencies. Also provides continuous manual adjustment of display beam, (the horizontal output voltage tracks the manual frequency).

(5) TRIGGER - In the AUTO position, the sweep re-triggers automatically. In the LINE position, the sweep is synchronized with the AC line frequency. In the EXT position, an external signal, applied through the rear panel EXT TRIGGER connector, can start the sweep. Alternatively, in the EXT position, a single sweep is started whenever the SINGLE SWEEP ((12)) pushbutton is pressed.

(6) RF OUT, dBm - Selects RF output level from +10 dBm down to -70 dBm in 10 dB steps. The variable center control provides continuous adjustment below each 10 dB step.

(7) SLOPE - Provides approximately a ±2 dB variation in slope of RF output over the full sweep width (that is, when centered at 750 MHz). Control is used to correct for any slope caused by external cables or other components in the test setup.

(8) MARKER SPACING, MHz - Can be used to select comb markers every 100, 25, 5, or 1 MHz, or to select external (EXT) markers. In the OFF position, the comb markers are not displayed. The markers are graduated in height for easy identification.

(9) SWEEP WIDTH, MHz/DIV. - Selects the frequency bandwidth to be swept. In the FULL position, the complete 1 to 1500 MHz band is swept. For the graduated positions, 100, 25, 5, and 1 MHz per division, the swept bandwidth is centered about the setting of the CENTER FREQUENCY (1) control. For example, if the latter control is set to 200 MHz and the SWEEP WIDTH setting is 5 MHz/DIV., then the frequency band is 50 MHz (5 MHz times the ten divisions on the display) and is swept from 175 to 225 MHz.

(10) WIDTH VERNIER - can be used for continuous expansion of each sweep width, as viewed on the CRT screen.

*Instruments with serial numbers 600001 through 600006 do not have this control.

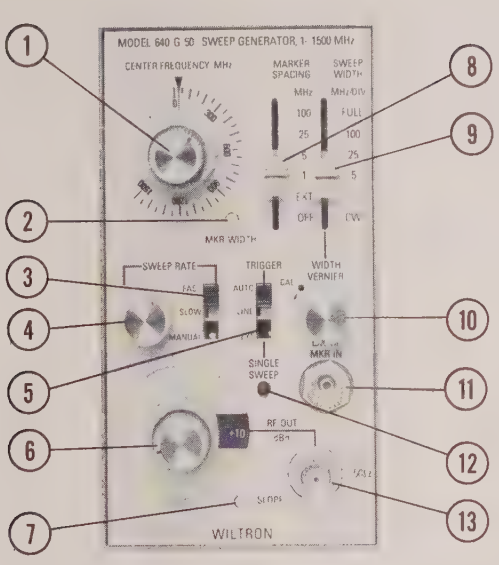


Figure 2-2. WILTRON Sweep Generator Plug-In, Model 640G

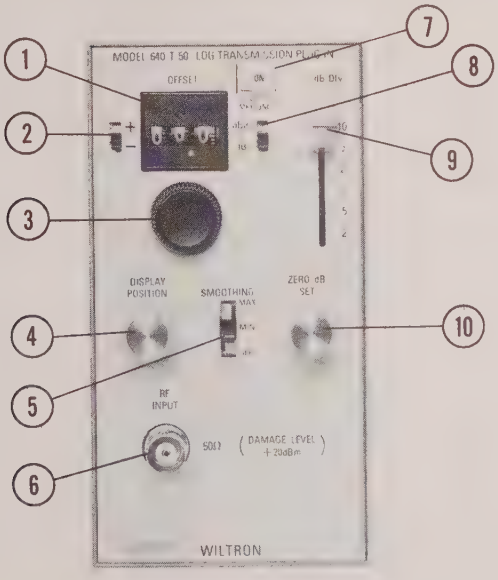


Figure 2-3. Log. Transmission Plug-In, Model 640T

(11) EXT RF MKR IN - External reference frequency markers can be applied through this BNC connector. The MARKER SPACING switch ((8)) must be in the EXT position. The signal level is 0 dBm nominal ±5 dBm (into 50 ohms).

(12) SINGLE SWEEP - When the TRIGGER switch ((5)) is in the EXT position, a single sweep can be triggered manually by pressing this pushbutton.

(13) RF Output connector.

2-2.4 Log. Amplifier Plug-Ins, Models 640T (Fig. 2-3) and 640E

The Model 640T Log. Transmission Plug-In and the Model 640E Log. Amplifier Plug-In have almost identical circuitry (except for the built-in detector on the Model 640T), and the controls of the two plug-ins are identical.

(1, 2, 3) OFFSET - Knob and readout provide a calibrated offset that is continuously variable over a greater than 90 dB range. The sign (±) switch selects the polarity of the offset.

(4) DISPLAY POSITION - Adjusts the vertical position of the display trace.

(5) SMOOTHING - Filters reduce the effect of noise when making measurements of low-level signals. Switch has three positions: MAX, MIN, and OFF.

(6) RF INPUT - Input connection for signal to be measured (labeled INPUT on Model 640E). Maximum input signal without damaging the instrument is +20 dBm (100mW).

(7) ON - Press to output the main trace to the CRT. In the OFF position, only the retrace and markers are output to the CRT; (this means the OFF plug-in can be used to provide an adjustable frequency scale, when two plug-ins are used).

(8) dBm/dB - In the dBm position, the ZERO dB SET control (10) is disabled and the display is calibrated in dBm. In this case, the retrace line will correspond to whatever value the OFFSET reads; (if the OFFSET reads 00.0 dB, that is the reference). If the dB/dBm switch is in the dB position, the zero reference is set by the ZERO dB SET control.

(9) dB/DIV. - Selects a display sensitivity of 10, 5, 2, 1, 0.5 or 0.2 dB per division.

(10) ZERO dB SET - Adjusts the measured signal to the level desired to establish a 0 dB reference. This control is disabled when the dBm/dB switch (8) is set to the dBm position.

2-2.5 Log. Reflection Plug-In, Model 640R (See Fig. 2-4)

The controls and indicators and their functions are identical to those listed for Models 640T and 640E with the following exceptions: the maximum sensitivity (dB/DIV) is 0.5 dB, controls (2) and (8) have been omitted, and an output port (see Figure 2-4) has been added.

(6) SWR - The TEST PORT connector connects to the device under test. The RF INPUT is connected to the RF Output from the Model 640G Sweep Generator. A semi-rigid cable is supplied for this latter connection. For purposes of identification, the 50-ohm cable and the 75-ohm cable are both clearly labeled. There is a 6 dB difference in the signal level between the RF INPUT and the TEST PORT because of the loss across an internal SWR autotester (SWR bridge).

2-2.6 Linear Amplifier Plug-In, Model 640L (See Fig. 2-5)

The controls and indicators and their functions are identical to those of Models 640T and 640E (Fig. 2-3) with the exceptions noted. This plug-in is provided for applications where the vertical presentation is desired in linear rather than logarithmic units.

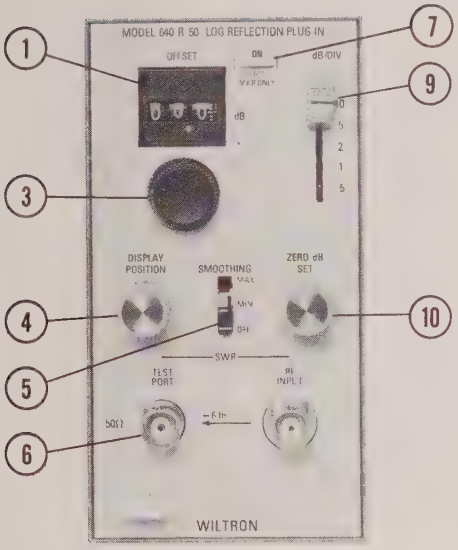


Figure 2-4. Log. Reflection Plug-In, Model 640R

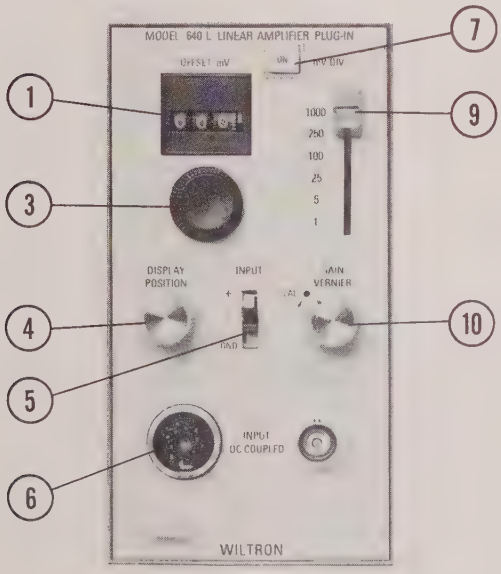


Figure 2-5. Linear Amplifier Plug-In, Model 640L

(1,3) OFFSET mV - Offset is calibrated in millivolts, and is adjustable from 1 to 1000 millivolts.

(2) (Omitted)

(6) INPUT DC COUPLED - In general, any RF diode detector with positive or negative DC output may be used for input to this unit. WILTRON units, which provide maximum sensitivity and minimum ground-path pickup and are therefore recommended, connect to the left-hand input. For example, a WILTRON Model 6 SWR Autotester (SWR bridge) is used for reflection measurements; a WILTRON Model 7 RF Detector is used for transmission measurements. The right-hand input is used for other devices having a BNC connector.

(8) (Omitted)

(9) mV/DIV - Selects a display sensitivity of 1000, 250, 100, 25, 5, or 1mV per division.

(10) GAIN VERNIER - When moved from the CAL position, provides an uncalibrated display for convenient viewing. Use of this control does not change the position of the retrace line.

2-3 USING THE SYSTEM

Figure 2-6 provides a block diagram of the Model 640 RF Analyzer to show the measurement techniques utilized and to make clear the function of each amplifier front panel control. The main elements are the main frame (display) and three plug-in modules. The system always includes the Model 640G sweeper and one amplifier, in addition to the main frame. With one amplifier, the user may make either transmission or reflection measurements, depending upon the type and configuration. Since the display main frame has two vertical inputs, the addition of a second amplifier makes it possible to simultaneously display and measure two channels of information.

The system, as shown in Fig. 2-6, is configured for the simultaneous measurement of insertion loss (transmission) and return loss (reflection). Note that no external components are required. The Model 640R (Reflection) amplifier has its own internal SWR bridge and RF detector; the Model 640T (Transmission) amplifier has an internal RF detector. Other configurations are of course possible. For example, two Model 640E log. amplifiers may be used. These require external SWR bridges and/or detectors, but would provide a greater physical flexibility for the measuring system's configuration. The choice depends upon the user's requirements.

The Model 640G RF Generator provides the swept RF signal and the sweep ramp; the latter (plus markers) goes to the display unit and provides the horizontal deflection signal. The RF sweep output signal is fed to the RF INPUT of the Model 640R Reflection amplifier, where it is applied to the SWR Autotester. The SWR Autotester is a broad-band reflection bridge with a built-in detector. It presents a forward (transmission) signal at the front panel TEST PORT, while the reflected signal (for the test device) appears at the internal RF detector. The directivity of the SWR Autotester is very high, at least 40 dB over the full 1-1500 MHz band. A DC log. conversion amplifier, having a 70 dB dynamic range, completes the reflection measuring equipment.

Both the Model 640T and 640E plug-ins use the same internal log. amplifier PC assembly. In the Model 640T Transmission amplifier, the log. amplifier is preceded by a wideband RF detector.

2-3.1 The Log. Amplifier Plug-In

Figure 2-7 is a detailed block diagram of the log. amplifier plug-in, and shows the internal arrangement of controls that enable the operator to set the reference and then measure scalar quantities. The DISPLAY POSITION and ZERO dB SET controls establish the initial horizontal

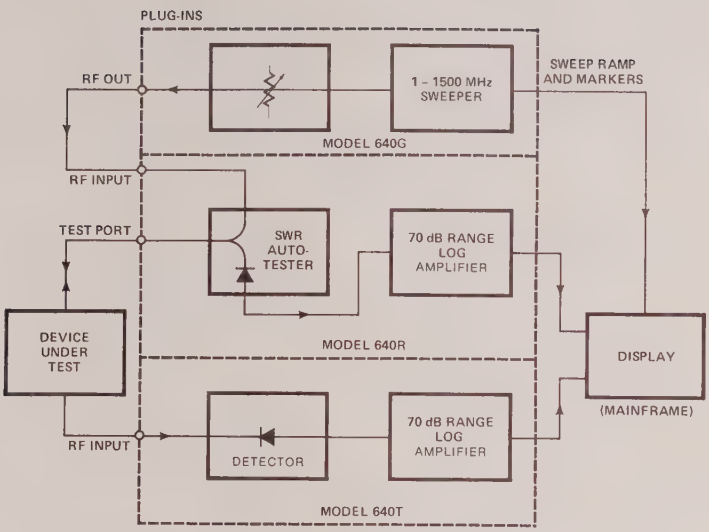


Figure 2-6. Block Diagram, Model 640 RF Analyzer System

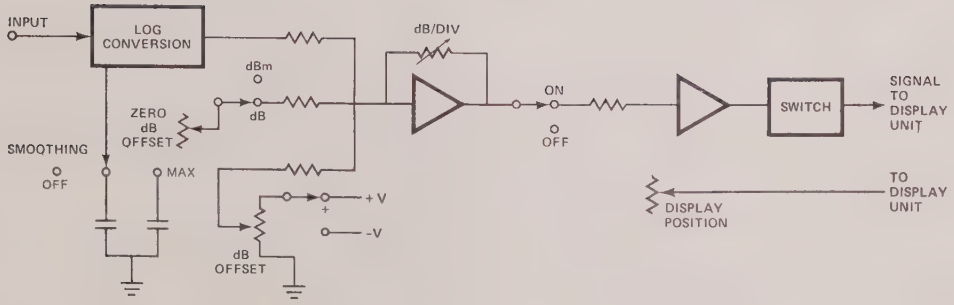


Figure 2-7. Detail, 70 dB Range Log. Amplifier Plug-In

reference; the dB/DIV control establishes the scale sensitivity. The plug-in also has a dB OFFSET control, calibrated in tenths of a dB, with a range of ±90 dB. It is useful at low signal levels to bring portions of the swept data onto the screen for viewing with high vertical resolution, while retaining the vertical calibration of the display system.

2-3.2 Typical Measurement Display

Measurement quantities are read directly on the large CRT display, having an 8 x 10 graticule of 1/2-inch divisions. This is considerably larger than most instruments, which use a screen of 8 x 10 cm. Figure 2-8 shows a typical measurement of both insertion loss and return loss for a bandpass filter. Since the sensitivity setting (dB/DIV) was 10 dB per vertical division on the transmission channel, the dynamic range is approximately 60 dB (to the skirts of the filter passband). Note that both insertion loss and return loss are presented directly in dB below the reference line.

2-3.3 Measuring Frequency

The swept band frequencies are read with high accuracy by means of the crystal-controlled markers. These have an accuracy of 0.01%, and the spacing is selectable at 1, 5, 25 and 100 MHz. The markers for different frequencies are easily identified, as they are graduated in height in a 1:1, 2:1, 3:1 and 4:1 sequence. This is illustrated in Figure 2-9, which shows the appearance when all four markers are on. In Figure 2-8 the marker spacing is 1 MHz and the calibrated sweep is set a 1 MHz per division. The 5 MHz markers are easily identifiable. These markers can also be tilted (up to ±45°) for ease in identification on a steep-slope portion of the trace.

Figure 2-10 shows another convenient feature of the Model 640 RF Analyzer: If the amplifier for one channel is turned off, the frequency markers continue to appear and provide an easy-to-read reference for the "on" channel.

The RF generator provides a full-band sweep from 1 to 1500 MHz (identified on the Model 640G front panel as FULL), plus four calibrated higher-resolution sweep ranges of 100, 25, 5 and 1 MHz per division. These latter ranges are centered about whatever frequency the operator has selected.

Figure 2-11 illustrates the ease with which the operator can select a frequency of interest, then switch to one of the calibrated ranges to expand the display about that point. In 2-11(A) the operator has selected FULL (0 to 1500 MHz) and then used the CENTER FREQUENCY to place a variable marker at 900 MHz. In 2-11(B) he has switched to a sweep width of 25 MHz per division and a marker spacing of 100 MHz. The 900 MHz marker is now centered on the display.

Figure 2-11(C) illustrates the frequency range if any of the 4 calibrated ranges had been selected. The variable marker does not appear when one of the calibrated high-resolution sweep ranges is selected.

In summary, the Model 640 RF Analyzer is easy and convenient to use. In most instances, the setup is extremely simple since the system contains all needed measuring elements. After establishing a zero reference level, it is only necessary to connect the test device to the input and output of the analyzer. The performance characteristics are then read directly on the screen, or from the front panel control settings. The parameters of interest (which can be read directly) include swept frequency range, applied RF power, transmission, and the frequency limits of the device under test.

In general, once the system has been set up and the reference levels established, a number of devices can be measured without further adjustments.

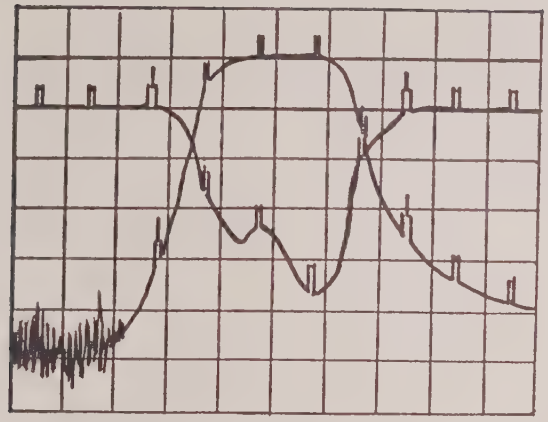


Figure 2-8. Typical Measurement Traces

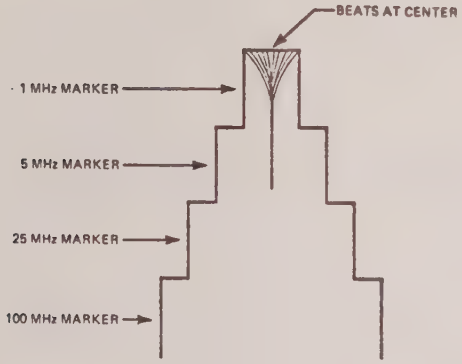


Figure 2-9. Frequency Marker Arrangement

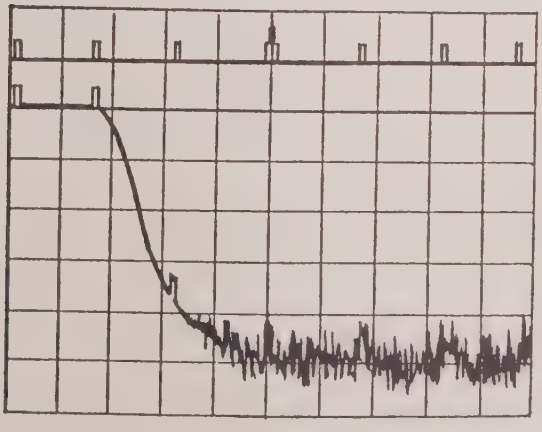
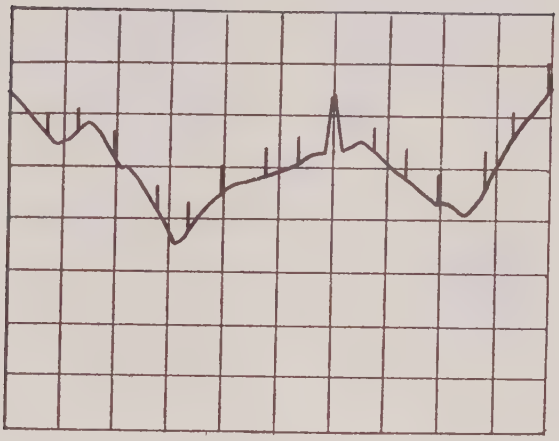
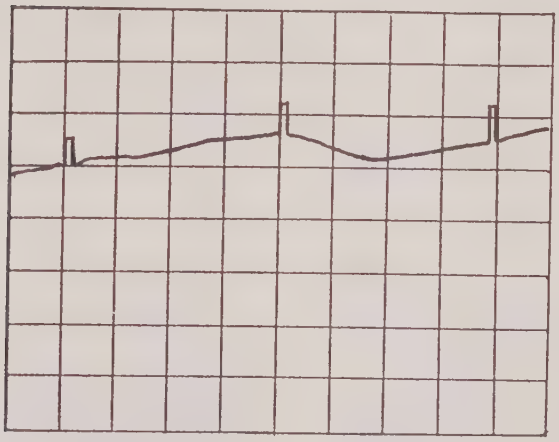


Figure 2-10. Using the "Off" Channel to Identify Markers



(A) Full Width



(B) 25 MHz per Division (100 MHz Markers)

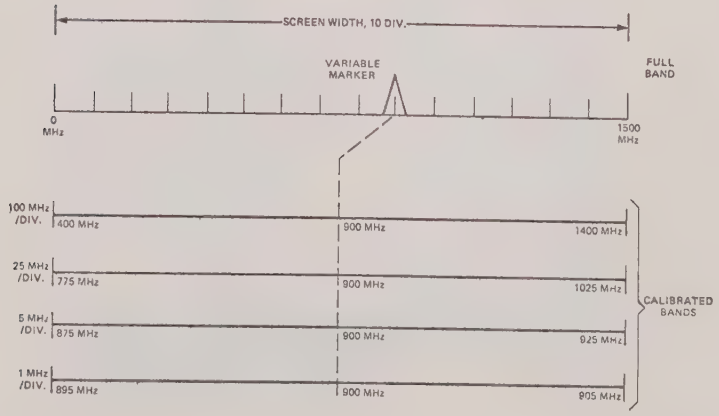


Figure 2-11. Selecting Center Frequency and Sweep Width

2-4 OPERATING INSTRUCTIONS

The following tables contain detailed instructions for initializing and operating the system.

Table 2-1 describes the procedure for preliminary setup, followed by instructions for setting the zero reference lines on both channels. The procedure applies specifically to a configuration such as that shown in Figure 2-6 using the Model 640R and 640T log. amplifiers, but the instructions are general enough (with minor differences) to apply to other amplifiers and other system configurations. This table is intended to assist the operator who is using the system for the first time.

Paragraph 2-4.1 describes in detail the procedure for making simultaneous transmission and reflection measurements on a bandpass filter, where the exact frequency is not known in advance. This example is intended primarily to assist a new operator in becoming familiar with the use of the RF Analyzer system.

Paragraphs 2-4.2 through 2-4.4 contain operating instructions for different system configurations, using all types of amplifiers.

Paragraph 2-4.5 gives operating hints and precautions.

Table 2-1. Initialization

A. PRELIMINARY SET-UP

1. Model 640G Sweep Generator

CENTER FREQUENCY:	0 MHz
Vernier:	Centered
MARKER SPACING:	100 MHz
SWEEP WIDTH:	FULL
WIDTH VERNIER:	CAL
SWEEP RATE:	FAST
Vernier:	Clock-wise
TRIGGER:	AUTO
RF OUT:	0 dBm
Vernier:	Centered

Connect a rigid cable from RF OUTPUT of the Model 640G to RF INPUT of the Model 640R Amplifier.*

2. Model 640R and 640T Log. Amplifiers*

ON Switch:	OFF (Out)
OFFSET:	00.0 dB
dBm/dB:	dB (Model 640T only)
dB/DIV:	10
SMOOTHING:	OFF

*If the system uses Model 640E amplifiers, see the configuration and test procedure in paragraph 2-4.3.

Table 2-1. Initialization (Continued)

b. SETTING ZERO REFERENCES

1. Main Frame

POWER:	ON (Pull Out)
INTENSITY:	As desired
FOCUS:	As desired
MARKER:	
TILT:	Adjust for vertical
AMPL:	As desired

2. Model 640R and 640T Log. Amplifiers

DISPLAY POSITION:	Adjust so reference traces are about 3 vertical divisions apart and near the center (see Fig. 2-12)

Make sure that no cables or devices are connected to the TEST PORT of the Model 640R Amplifier.

ON switch (Model 640R only):	ON (Push In)
ZERO dB SET (Model 640R only)	Adjust so trace (with markers) falls on zero reference line (see Fig. 2-12)*

THE MODEL 640R AMPLIFIER IS NOW CALIBRATED.

Turn OFF the Model 640R amplifier.

Connect a short cable from the TEST PORT (Model 640R) to the RF INPUT (Model 640T).

ON switch (Model 640T only):	ON (Push In)
ZERO dB SET (Model 640T only):	Adjust so trace falls on zero reference line

THE MODEL 640T AMPLIFIER IS NOW CALIBRATED.

ON switch (Model 640R)	ON (Push In)
DISPLAY POSITION: }	Adjust as desired to establish reference lines. (If a loss is expected, set lines near top of display and set OFFSET on Model 640T to + .)
OFFSET: }	

THE 640 SYSTEM IS NOW CALIBRATED AND READY TO MAKE MEASUREMENTS.

*For purposes of discussion, we have separated the two reference traces. In actual use, the operator may prefer to have both references on the same graticule line.

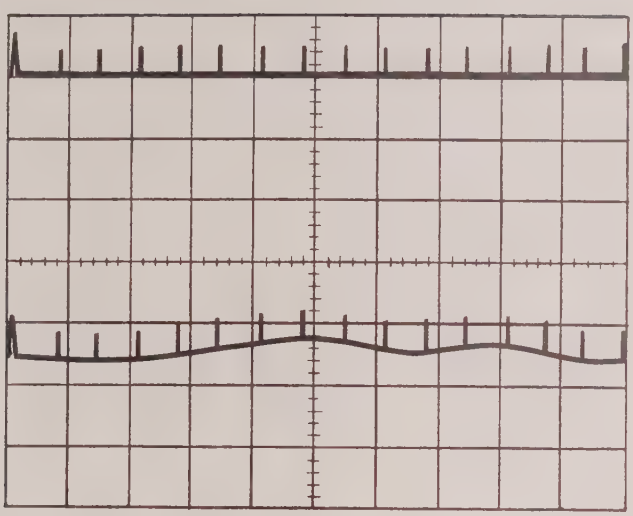
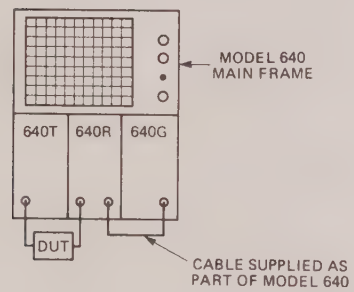


Figure 2-12. Setting the Zero dB Reference

2-4.1 Example Measurement



1. Complete the initialization of the system (Table 2-1).
2. Connect test bandpass filter as shown above.
3. Turn off Log. Reflection Amplifier (Model 640R).
4. Make sure SWEEP WIDTH control (Model 640G) is set to FULL.
5. Identify the fundamental response of the filter (see Fig. 2-13), and set CENTER FREQUENCY control (Model 640G) so that marker is exactly aligned to peak.

NOTE

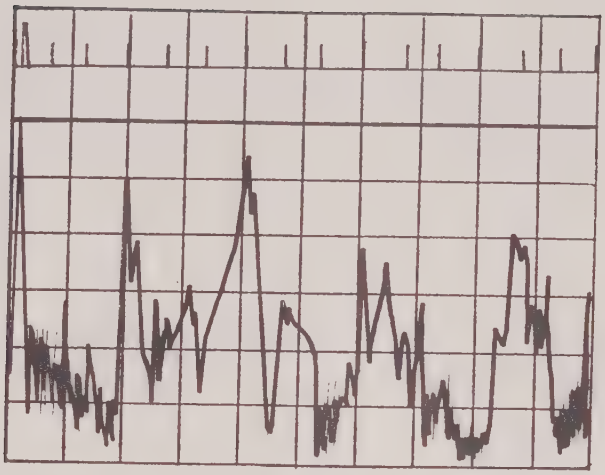
In the example shown in Fig. 2-13A, the fundamental is approximately 30 MHz.

6. Select a calibrated SWEEP WIDTH (Model 640G) approximately equal to the bandpass of the filter.

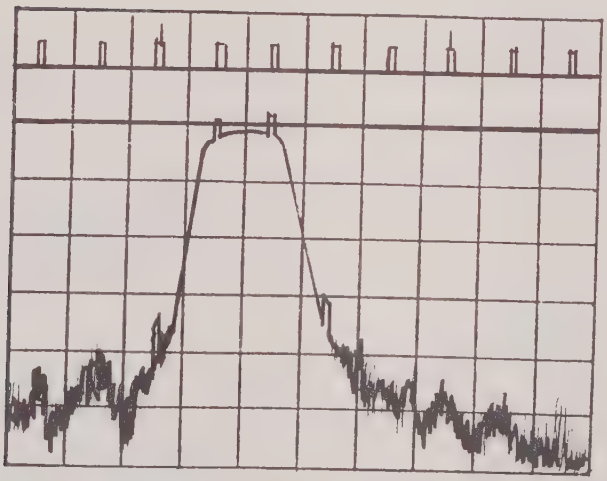
NOTE

In the example in Fig. 2-13B, the bandwidth of the filter is approx. 5 MHz.

7. Use the vernier on the CENTER FREQUENCY control (Model 640G) to center the trace, and WIDTH VERNIER to expand the trace as desired. Select MARKER SPACING as required for reading frequency. Adjust MARKER TILT if necessary.
8. Turn on the Model 640R Log. Amplifier. Adjust the dB/DIV controls on both amplifiers for desired sensitivity.
9. Read return loss and insertion loss directly on the calibrated display.



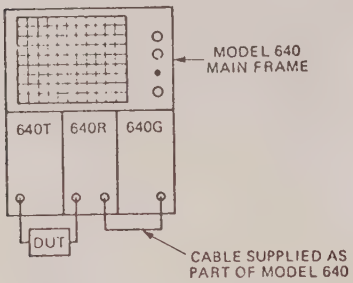
(A) Display Presentation for FULL Sweep



(B) Display Presentation for 5 MHz/DIV Sweep

Figure 2-13. Example Measurement, Bandpass Filter

2-4.2 Simultaneous Transmission and Reflection Measurements Using the Model 640R and 640T Log. Amplifier Plug-Ins



1. Connect the power plug to the AC power source. Pull out the POWER switch to turn on the system power.
2. Set the INTENSITY and FOCUS controls for the desired brightness and focus.
3. Set the CENTER FREQUENCY control on the Sweep Generator plug-in for the center frequency required for the test.
4. Set the SWEEP WIDTH and WIDTH VERNIER controls for the sweep width to be used for the test.
5. Set the SWEEP RATE and TRIGGER switches for the type of display required.
6. Set the RF OUT step attenuator for the appropriate test level in dBm.
7. Set the ON switch at the top of the Model 640R to the ON position (push in).
8. On the Model 640T and 640R plug-ins, set the OFFSET + - switches to - .

NOTE

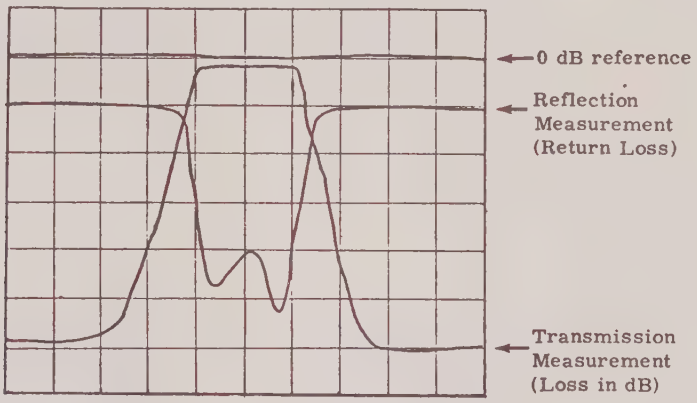
If the device under test is an active type, a transmission gain may be measured. In this case, set the OFFSET + - switch on the Log. Transmission Plug-In to + .

9. Set the OFFSET controls on the Log. Transmission and Reflection plug-ins to 00.0 .
10. Adjust the DISPLAY POSITION controls on the Log. Transmission and Log. Reflection plug-ins to establish reference lines at the desired position on the display. The center of the screen is usually used if it is not known whether a gain or loss will be measured. If a transmission loss and a return loss are expected to be measured, place the reference lines near the top of the display.
11. Attach the semi-rigid cable supplied with the system to the RF OUT connector on the Sweep Generator Plug-In, and the RF INPUT connector on the Log. Reflection Plug-In.
12. Ensure that there is no connection made to the TEST PORT connector on the Log. Reflection Plug-In. This establishes a reference for 0 dB return loss. Adjust the ZERO dB SET control on the Log. Reflection Plug-In so that the trace is coincident with the reflection reference line set in step 10. Turn off the Model 640R amplifier, and turn on the Model 640T.
13. Connect a short cable from the TEST PORT connector on the Log. Reflection Plug-In to the RF INPUT connector on the Log. Transmission Plug-In. This establishes a reference for 0 dB transmission loss or gain. Adjust the ZERO dB SET control on the Log. Transmission Plug-In so that the trace is coincident with the transmission reference line set in step 10. Disconnect the cable.
14. Connect the input of the device under test to the TEST PORT connector on the Log. Reflection Plug-In. Connect the output of the device under test to the RF INPUT connector on the Log. Transmission Plug-In. Turn the Model 640R amplifier on again.
15. Check if a readable display is obtained for both transmission and return loss. If not, set the dB/DIV switches on each

plug-in so that the transmission and return loss displays occupy most of the graticule, as shown in the example in Figure 2-14.

16. Read the transmission loss (or gain) and the return loss in dB of the device under test by multiplying the number of graticule divisions by the dB/DIV setting. Figure 2-14 shows the transmission loss and return loss of a typical bandpass filter.

17. If frequency markers are desired, set the MARKER SPACING and MKR WIDTH controls on the Sweep Generator Plug-In for the reference required. Use the main frame MARKER TILT and AMPLITUDE controls to obtain optimum markers.



Example:

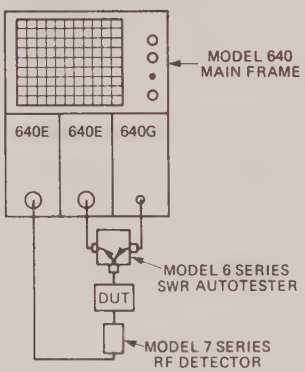
Transmission: 5 dB/DIV = approx. 1 dB loss in the center of the passband, and 30 dB loss outside the passband.

Reflection: 5 dB/DIV = approx. 20 to 26 dB return loss in the passband, and 5 dB return loss outside the passband.

Figure 2-14. Typical Transmission Loss and Return Loss Display for Measurement of a Bandpass Filter

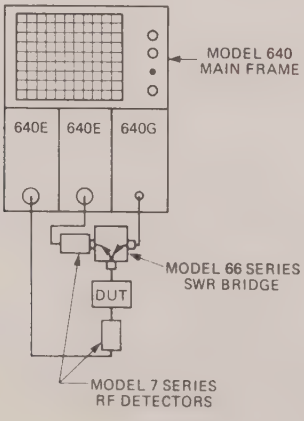
2-4.3 Simultaneous Transmission and Reflection Measurements, Using Two Model 640E Log. Amplifier Plug-Ins

An external WILTRON Model 6 Series Autotester and Model 7 Series RF Detector can be used with the Model 640 for test setups where the device under test cannot be conveniently connected to the front panel. In this test setup, the WILTRON Model 6 Series Autotester and Model 7 Series RF Detector are used in conjunction with two Model 640E Log. Amplifier Plug-Ins.



Test Setup for Using an External Autotester and RF Detector

It is possible to use the Model 640 to make return loss measurements with 60 dB directivity. For this purpose, two Model 640E Log. Amplifier Plug-Ins are installed in the Model 640 Main Frame, and are used with an external precision SWR bridge such as the WILTRON Series 66.



Test Setup for High-Precision Transmission and Return Loss Measurements

1. Connect the power plug to the AC power source. Pull the POWER switch out to turn on the system power.
2. Set the INTENSITY and FOCUS controls for the desired brightness and focus.
3. Set the CENTER FREQUENCY control for the center frequency required for the test.
4. Set the SWEEP WIDTH control for the sweep width required for the test device.
5. Set the SWEEP RATE and TRIGGER controls for the type of display desired.
6. Set the RF OUT step attenuator for the appropriate signal level in dBm.
7. Set the OFFSET controls on both Log. Amplifiers to 00.0 dB. Set the OFFSET + - control on the transmission channel amplifier to - for expected loss, to + for expected gain.
8. Adjust the DISPLAY POSITION controls on both log. plug-ins to establish reference lines on the display. If a loss is expected, place the reference lines near top of the display.
9. Connect an SWR autotester (or SWR bridge and RF detector) to Model 640G and 640E plug-ins (see diagrams).

NOTE

DO NOT ATTACH TEST DEVICE TO TEST PORT OF BRIDGE OR SWR AUTOTESTER. TEST PORT MUST BE OPEN TO ESTABLISH a 0 dB REFERENCE.

10. Turn ON the Log. Reflection amplifier plug-in. Adjust the ZERO dB SET control so that the trace is aligned with the reference established in step 8.
11. Turn OFF the log. reflection plug-in amplifier. Turn ON the log. transmission plug-in amplifier.
12. Connect a Model 7 Series RF Detector to the input of the Log. Transmission plug-in. Connect a short cable from TEST PORT of SWR Autotester (or SWR Bridge) to input of RF detector.

13. Adjust the ZERO dB SET control on the log. transmission plug-in to make trace coincident with the reference line established in step 8.
14. Disconnect cable; connect the test device between TEST PORT of SWR Autotester (or SWR Bridge) and input of RF detector.
15. Check if a readable display is obtained. If not, set the dB/DIV and OFFSET controls as required. Read the transmission loss or gain directly on the display. (See Figure 2-14 for example.)
16. Turn ON the log. reflection plug-in amplifier. Set dB/DIV and OFFSET controls as desired.
17. To read frequency, set the MARKER SPACING controls as desired. The CENTER FREQUENCY VERNIER and sweep WIDTH VERNIER controls can be used to center the response, and to expand the display respectively.
18. Adjust MARKER TILT and AMPLITUDE controls as desired.

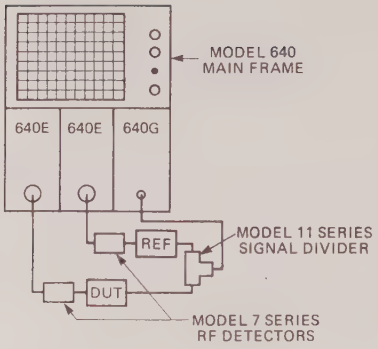
NOTE

If user is making only reflection measurements, be sure to terminate the output of the test device. Otherwise, inaccurate measurements will result.

2-4.4 Measurements Made to a Reference Standard, Using the Model 640E or 640T Log. Amplifier Plug-Ins

The transmission response of a test device can be compared to the response of a reference standard, using the test configuration shown. The WILTRON Model 11 Series Signal Divider is used with two Model 7 Series RF Detectors and two Model 640E Log. Amplifiers.

An alternate configuration would use two Model 640T Log. Transmission Plug-Ins. The external RF Detectors are then omitted, since these are incorporated into the Model 640T plug-in.



1. Connect the power plug to the AC power source. Pull the POWER switch out to turn on the system power.
2. Set the INTENSITY and FOCUS controls for the desired brightness and focus.
3. Set the CENTER FREQUENCY control for the center frequency required for the test.
4. Set the SWEEP WIDTH control for the sweep width required for the test device.
5. Set the SWEEP RATE and TRIGGER controls for the type of display desired.
6. Set the RF OUT step attenuator for the appropriate signal level in dBm.
7. Set the OFFSET controls on both plug-ins to 00.0 dB. Set the OFFSET + - control to - if a loss is expected, or to + if a gain is expected.
8. Adjust the DISPLAY POSITION controls on both log. plug-ins to establish reference lines on the display. For a loss, place the reference lines near the top of the display.
9. Connect a WILTRON Model 11 Series Signal Divider to Model 640G sweeper. Connect outputs of signal divider to Model 7 Series RF Detectors (see configuration drawing).

NOTE

If Model 640T Log. Transmission plug-ins are used instead of Model 640E Amplifiers, the RF detectors are not used.

10. Connect short cables from RF detectors to inputs of log. plug-ins.

11. Turn on both plug-ins (ON switch pressed in). Adjust the ZERO dB SET control on each plug-in to make trace coincident with the reference line established in step 8.
12. Disconnect cables and connect reference standard between RF detector and divider in one channel, and test device in other channel.
13. Check if a readable display is obtained. If not, set the dB/DIV and OFFSET controls on both amplifiers. Read the relative gain or loss directly on the display.
14. To read frequency, set the MARKER SPACING controls as desired. The CENTER FREQUENCY vernier and sweep WIDTH VERNIER can be used to center the response curve and to expand the display as desired.
15. Adjust MARKER TILT and AMPLITUDE controls as desired.
16. The system is now ready to compare a sequence of test devices against the standard.

2-4.5 Operating Hints

Power Readings

a. When making an absolute power reading, the dB/dBm switch on the Log. Amplifier must be in the dBm position. This disables the ZERO dB SET control. To establish the reference level for the display trace, it is only necessary to set the DISPLAY POSITION control.

b. If the display trace is off-scale, use the OFFSET + - control and the calibrated OFFSET dB control to bring the trace back onto the display.

RF Sweep Output Level

For calibrated output, the RF OUT vernier on the Model 640G must be at approximately the 3 o'clock position. For an absolute output, connect the RF output of the sweep generator to the Log. Transmission input, then read the absolute power level in dBm while adjusting the RF OUT vernier.

The relative accuracy of each setting of the 70 dB step attenuator on the sweep generator varies from ±0.3 dB (on the 10 dB step) to ±0.7 dB (on the 70 dB step).

Terminations

When making reflection measurements only, be sure to terminate the output of the test device in the characteristic impedance.

When making transmission measurements with a Model 11 Series Signal Divider, if only one channel is used, be sure to properly terminate the other output of the divider.

Beam Finder

In some instances, the BEAM FINDER control may be quicker than the OFFSET + - and OFFSET dB controls in determining the direction in which a trace is off-screen.

Sweeps at Low Center Frequency

If the absolute center frequency setting is less than half of the sweep width setting, then two response curves may appear on the screen. This is normal. In general, the curve to the left is an "image" and can be ignored.

Table 2-2. Return Loss - SWR - Reflection Coefficient Conversion Chart

Return Loss dB	SWR	Reflection Coefficient	Return Loss dB	SWR	Reflection Coefficient
1	17.3910	.8913	31	1.0580	.0282
2	8.7242	.7943	32	1.0515	.0251
3	5.8480	.7079	33	1.0458	.0224
4	4.4194	.6310	34	1.0407	.0200
5	3.5698	.5623	35	1.0362	.0178
6	3.0095	.5012	36	1.0322	.0158
7	2.6146	.4467	37	1.0287	.0141
8	2.3229	.3981	38	1.0255	.0126
9	2.0999	.3548	39	1.0227	.0112
10	1.9250	.3162	40	1.0202	.0100
11	1.7849	.2818	41	1.0180	.0089
12	1.6709	.2512	42	1.0160	.0079
13	1.5769	.2239	43	1.0143	.0071
14	1.4985	.1995	44	1.0127	.0063
15	1.4326	.1778	45	1.0113	.0056
16	1.3767	.1585	46	1.0101	.0050
17	1.3290	.1413	47	1.0090	.0045
18	1.2880	.1259	48	1.0080	.0040
19	1.2528	.1122	49	1.0071	.0035
20	1.2222	.1000	50	1.0063	.0032
21	1.1957	.0891	51	1.0057	.0028
22	1.1726	.0794	52	1.0050	.0025
23	1.1524	.0708	53	1.0045	.0022
24	1.1347	.0631	54	1.0040	.0020
25	1.1192	.0562	55	1.0036	.0018
26	1.1055	.0501	56	1.0032	.0016
27	1.0935	.0447	57	1.0028	.0014
28	1.0829	.0398	58	1.0025	.0013
29	1.0736	.0355	59	1.0022	.0011
30	1.0653	.0316	60	1.0020	.0010

Table 2-3. dBm - dBmV Conversion Chart (75-Ohm)

dBm	dBmV	dBm	dBmV
10	58.75	-30	18.75
0	48.75	-40	8.75
-10	38.75	-50	-1.25
-20	28.75	-60	-11.25

SECTION III
FUNCTIONAL DESCRIPTION

3-1 SCOPE

This section presents circuit descriptions for the main frame and all plug-ins of the Model 640 RF Analyzer. It provides essential background information for the maintenance technician who will troubleshoot or calibrate the system. All circuit discussion is at a block diagram level. System schematics can be found in Section VI at the end of this manual.

3-2 SYSTEM BLOCK DIAGRAM

Figure 3-1 is a simplified diagram of the 640 RF Analyzer and shows the 4 major components. The Main Frame, which contains the CRT display, holds the three plug-ins. The plug-in on the right side is the Model 640G Sweeper. The other two slots are for log. amplifier plug-ins. Those shown are the Model 640T Log. Transmission Plug-In and the Model 640R Log. Reflection Plug-In. Together, these two provide the user with the capability of making simultaneous scalar measurements of the transmission and reflection characteristics of a test device. The log. amplifier plug-ins contain all necessary RF components: the RF detector, or the RF detector and SWR bridge.

Other plug-in configurations are possible. The user may choose the Model 640E Log. Amplifier or the Model 640L Linear Amplifier. Both of these plug-ins have been discussed in Section II.

3-2.1 Sweep Generator

The main function of the sweeper is to generate the swept RF output used for the test. The SWEEP GENERATION block outputs the full sweep signal, used for sweeping the RF output and for horizontal deflection of the CRT beam. The user can select SLOW or FAST sweep rates. In the MANUAL position the SWEEP RATE vernier manually positions both the RF frequency and the CRT beam.

The ramp voltage is modified by the SWEEP WIDTH AND FREQUENCY CONTROL block. The operator can select either FULL sweep width (1 MHz to 1500 MHz) or calibrated sweep widths ranging from ±1 MHz per division to ±100 MHz per division. Each sweep range is centered about the frequency selected by the CENTER FREQUENCY control. Note that only the full ramp is used for horizontal deflection.

The RAMP SHAPER modifies the ramp voltage, correcting the shape in order to obtain a linear change in frequency versus time. The RF SECTION contains the voltage-tuned oscillators and precision balanced mixer needed to produce a high-quality RF source, free of spurious signals and harmonics. It also contains an RF amplifier, a level detector, and a modulator. The output of the RF SECTION is directed to a) the MARKERS block, b) the Automatic Leveling Control circuit (ALC), and c) the VARIABLE 70 dB ATTEN. The output to the ALC circuit is a detected sample of the RF level.

In the MARKER block, the RF output is beat against a precision crystal frequency to produce birdie markers at accurately-known frequencies. These markers are then directed to the vertical outputs of the log. amplifier plug-ins, where they are combined with the DC signal derived from the response of the test device.

The ALC circuit provides a feedback loop, monitoring the level of the RF signal and automatically compensating to produce a swept output that is constant with frequency. Note that a power switch (RETRACE OFF) is provided, to kill the RF output during a portion of the retrace time.

The VARIABLE 70 dB ATTENUATOR enables the user to select any output from -60 dBm to +10 dBm, in 10 dB steps. A vernier provides continuous variation within each step.

The RF OUT of the sweeper is usually connected directly, by rigid coax, to the RF INPUT of the Model 640R Log. Reflection Plug-In. The test device is then connected between the TEST PORT of the Model 640R and the RF INPUT of the Model 640T Plug-In.

3-2.2 Log. Amplifiers

In the log. plug-ins, the low-level input signal is amplified to produce an output proportional to the dBm level of the RF input power. These amplified DC signals then deflect the CRT beam vertically. The amplitude of the input signal is measured by noting the displacement of the beam during the sweep, relative to the graticules on the screen. The amplitude is known accurately by the setting of the dB/DIV control on the front panel of the log. plug-in.

The input to the Model 640R Log. Reflection Plug-In is a reflected signal, detected in the internal SWR AUTOTESTER. The DC level is then amplified and the log. conversion is accomplished in the LOG. AMPLIFIER. The output amplifiers are linear, and provide a sensitivity selection (dB/DIV), a ZERO dB SET, and an OFFSET. The latter enables the user to view any portion of the response curve without losing display calibration, even at high-sensitivity settings.

The markers are added to the output just before the signal is directed to the vertical input of the CRT display. The DISPLAY POSITION controls enable the operator to set his zero reference line to whatever graticule line he chooses.

The Model 640T and 640E log. plug-ins are very similar to the Model 640R. The major difference in the Model 640T, is the RF detector in place of the SWR Autotester at the input. The Model 640E Log. Amplifier has no internal RF components.

3-2.3 Main Frame (CRT Display)

The CRT Display is also the main frame, which houses the plug-in units. It consists of the CRT, the vertical and horizontal deflection amplifiers, and high-voltage supply (3.4kV) for the CRT, and the low-voltage supply, the latter acting as a DC source for the plug-ins as well as the circuits internal to the main frame.

The signal inputs to the CRT Display are the horizontal sweep ramp and the two vertical inputs from the two log. plug-ins. A 50 kHz chopper, internal to the CRT unit, chops the two signals at a 50 kHz rate, making simultaneous viewing possible.

3-3 SWEEP GENERATOR

Figure 3-2 is a block diagram of the Model 640G RF Sweeper. The major functional sections are:

1. Sweep Generation
2. Sweep Control (Frequency Instruction)
3. Marker Section
4. RF Section
5. Horizontal Deflection

3-3.1 Sweep Generation

This section of the block diagram contains the Trigger Circuit and Sweep Generator blocks. The Trigger Circuit outputs a +5V trigger pulse. Its beginning can be synchronized with an external trigger, with the line frequency, or the trigger pulses can be free-running (generated by an internal oscillator in the AUTO position). Note that a single sweep can be generated in the EXT position by pressing S5, the SINGLE SWEEP pushbutton. The trigger circuit also outputs a series of blanking pulses, coincident with the sweep retrace, which are used to disable both the RF Generator and the log. amplifiers in the plug-ins during retrace time.

The sweep generator block outputs a 0 to 10V sweep ramp, whose start is synchronized with the start of the trigger pulses from the trigger circuit. The rate of this sweep ramp can be varied in two ranges from 0.02 to 100 seconds in duration. The rate (FAST or SLOW) is selected by the SWEEP RATE controls S5 and R2. When S5 is in the MAN (manual) position, R2 selects a DC output voltage. This enables the operator to manually position both the beam and the CW frequency from the RF Section. The range of the frequency is, of course, determined by the settings of the controls in the Frequency Instruction block.

3-3.2 Frequency Instruction

This section consists of the circuitry and controls for selecting the sweep width and the center frequency. The SWEEP WIDTH control (FULL, 100, 25, 5, 1 MHz, or CW) selects the mode. When FULL sweep is selected, the CENTER FREQUENCY control (R1) positions a frequency marker. In any of the calibrated sweep modes, R1 sets the center frequency of the sweep. In the CW mode, the same control sets

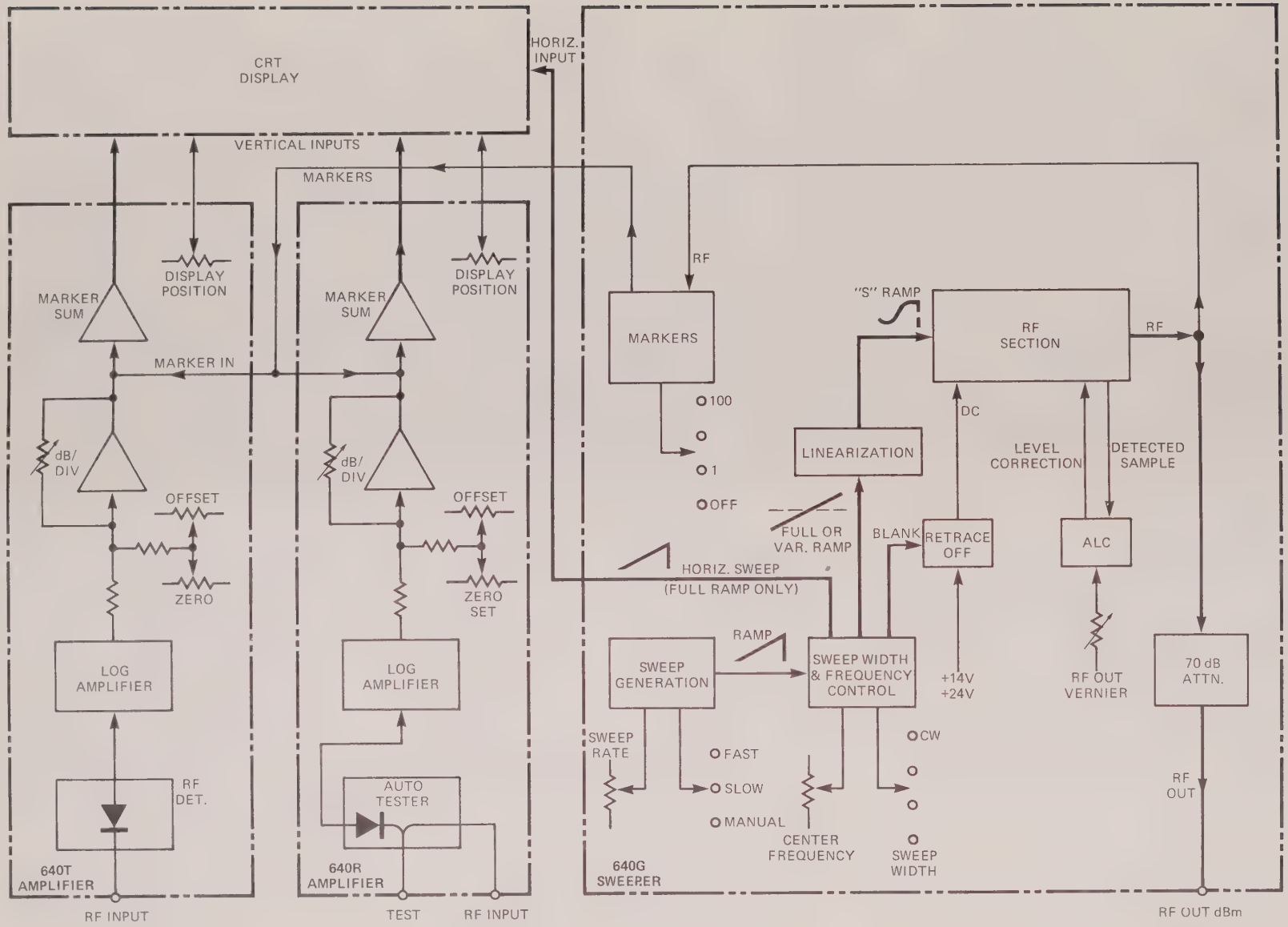


Figure 3-1. Model 640 RF Analyzer, Simplified Block Diagram

the CW frequency. The WIDTH VERNIER is usually in the CAL (calibrated) position. It can be used to decrease the sweep width, expanding resolution, if desired.

Figure 3-3 shows the elements of this section in more detail. The 0 to 10V ramp from the sweep generator is first buffered (U14C), then offset by the resistor network and U14A. The output from U14A is a ramp ranging from +3.33V to -3.33V, with the center at 0V. When one of the calibrated sweep widths is selected by S1 (SWEEP WIDTH), the enable logic (U17) and the OUTPUT SELECT SWITCH (U9) direct the ramp through S1 and R2. These two, by selectively attenuating the ramp voltage, provide a selection of frequency excursions. Note that this ramp is then summed with a DC voltage from the CENTER FREQUENCY control. This setting therefore determines the center frequency about which the ramp varies.

When the SWEEP WIDTH control is in the FULL position, the enable logic (U17) and output switch (S9) select the full ramp, 0 to 10V, for output. This is taken directly from buffer U14C. With the SWEEP WIDTH in the FULL position, the CENTER FREQUENCY control provides a DC voltage representing the center frequency. This is taken from the output of summing amplifier U7B, and directed to the marker circuits to form the variable frequency marker.

When the SWEEP WIDTH control is in the CW (continuous wave) position, the enable and switching logic outputs a DC voltage (from the CENTER FREQUENCY control). This goes to the RF Section to determine the CW frequency. Regardless of the position of the SWEEP WIDTH control, the full sweep ramp (0 to 10V) is always used for the output to the horizontal deflection circuits.

3-3.3 Marker Section

The Marker Section contains the Marker Control, Marker Generator, and Center Frequency Marker blocks. The Marker Control block provides enable signals for the Marker Generator, which contains the crystal-controlled oscillator, from which the marker frequencies are generated. The frequencies are selected by the MARKER SPACING switch, S2. The birdie markers are formed by beating the marker frequencies against the swept RF output.

Figure 3-4 shows these three blocks in greater detail. Note that both the Marker Control circuit and the Center Frequency Marker are enabled by signals from the Frequency Instruction section, and inhibited during retrace by a blanking signal from the Trigger Circuit. The FULL SWEEP enable turns the Center Frequency Marker on only when the full sweep has been selected.

The center frequency marker is generated by comparing the DC voltage (representing center frequency) with the full sweep ramp. Both of these signals come from the Frequency Instruction section. At the beginning of the sweep (ramp = 0V), the input to the non-inverting pin of U14D is zero and the amplifier is saturated, making the output -13V. When the sweep ramp rises to the exact value of the DC voltage representing the center frequency position, the two inputs are balanced and the output rises rapidly to zero. As the sweep ramp voltage continues to rise, the amplifier rapidly saturates again and the output is now +13V. It should be noted that this entire transition occurs within a few millivolts of the true balance condition.

The center frequency marker is produced in the output of U15A. This output is positive, except for the moment when the two input signals are equal. When the output of U14D is -13V, CR15 conducts, making the inverting input of U15A negative. The output is therefore saturated in the positive direction. At the point where the output of U14D makes the transition from - to +, U15A comes out of saturation and the output drops toward zero. But as the output of U14D becomes positive, CR15 shuts off and CR16 starts to conduct. This connects a + signal to the non-inverting input of U15A, and the output saturates once more. During the time of transition, the + bias through R124 to the inverting input of U15A actually causes the output to go approximately 0.6V negative. This negative pip is centered precisely at the time the full sweep ramp passes through the DC value representing the center frequency.

The center frequency marker is then summed in U15D with the markers from the Marker Generator. The amplitude can be adjusted by means of the MARKER AMPL control. The output of the Marker Section is directed to two places: 1) the log. amplifiers in the plug-ins, where the markers are combined with the test signals going to the vertical input, and 2) to the MARKER TILT control at the input of the Horizontal Deflection section (see Fig. 3-2).

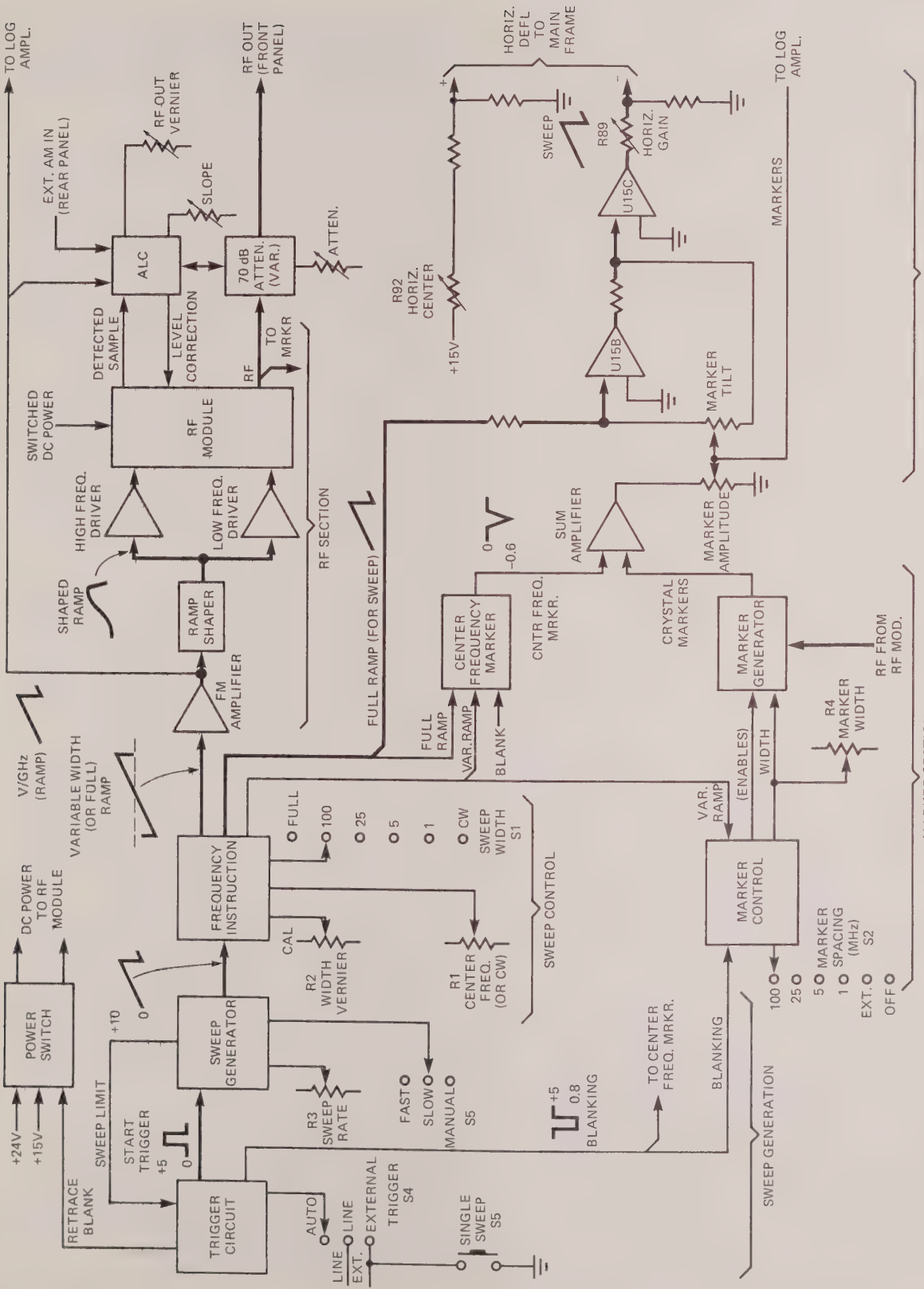


Figure 3-2. Model 640G Sweep Generator, Simplified Block Diagram

3-3.4 RF Section

The elements of the RF Section (see Figure 3-2) are the FM Summing Amplifier, the Ramp Shaper, RF Module, Automatic Leveling Control (ALC), and the variable output attenuator. The main input to the summing amplifier is the output from the Frequency Instruction section. This input may be the full sweep ramp, the attenuated ramp, or a DC voltage representing the selected CW frequency. As an alternate input (rear panel), an external FM ramp of 0 to 15V can be used for full sweep; for calibrated sweep widths, the ramp should have a slope of 10mV/MHz, up to a maximum value of ±10V.

The major output of the RF Section is the RF OUT dBm to the front panel. The level is manually controlled by the setting of the variable 70 dB attenuator (and vernier). Once set, the level is maintained at a constant amplitude during sweep by the ALC circuit. Note that an external AM signal (rear panel) can be used to amplitude modulate the output RF by means of the ALC circuit. A second output is the V/GHz signal, which goes to the log. amplifiers in the plug-ins. The purpose of this ramp voltage is explained later (see Section 3-4).

Figure 3-5 shows the details of the FM Summing Amplifier, Ramp Shaper, and drivers for the RF module in greater detail. It also identifies those controls and adjustments needed by the technician during calibration.

The Gain Adjustment (R130) in the output of the summing amplifier sets the maximum limit of the ramp at -10V. The Ramp Shaper provides four distinct breakpoints, each adjustment varying the stage gain (and hence the slope) providing precise correction for non-linearities in the VTO's within the RF module. Controls R162, R157, R172, and R167 at the input to the two drivers, provide independent adjustments of the high and low ends of the two ramps.

The FM/NORMAL switch is located on the sweeper PC board. When it is in the FM position, the sweep ramp or DC tuning voltage still comes from the Frequency Instruction circuit, but the EXTERNAL FM input (via the rear panel) is also connected. This external input can be used in several ways, of which remote tuning and phase-lock operation are two obvious examples. In the first example, the operator would logically select CW for the SWEEP WIDTH.

When in the NORMAL mode, the external input is grounded. Note that in NORMAL mode, when CW is selected, additional filtering is connected across the output of the High Frequency VTO driver to reduce noise.

The RF module (Figure 3-6) contains two oscillators operating in the 4 to 5 GHz range, the outputs of which are mixed in a special balanced mixer to keep spurious signals well down in level. The addition of the RF detector and the voltage-controlled attenuator (VCA) permit automatic level control (ALC) or AM by means of an external AM signal. The ALC loop instantly senses any change in the level of the RF output, amplifies this change, and feeds it back to the VCA to cancel the change.

The ALC loop works by maintaining a zero level at the junction of R24 and R25. In general, the output of U5 will be equal to whatever voltage appears at the top of the RF POWER VERNIER. This voltage can rise by an amount equivalent to 10 dB of power, through adjustment of this vernier. Note that an external AM signal is also introduced at this point.

If the voltage at the junction of R24 and R25 is not zero, the Level Summing Amplifier U4 inverts the voltage, amplifies it, and applies it to the VCA in the RF module. The RF output power is then increased or decreased until the detected RF level into U5 has changed enough to bring the "zero point" back to zero.

The output of the RF detector in the RF module is connected to the non-inverting input of U5. Since the detected RF level is not exactly zero for zero RF from the RF module, a resistive network applies a very small negative bias to the other input of U5 as compensation.

Note also that a portion of the V/GHz ramp from the FM summing amplifier is fed through U3A to R9, the front panel SLOPE control, and that this signal, too, is applied to R25. By adjustment of R9, either a positive or negative output slope can be obtained. This corrects the RF output to compensate for slope characteristics of external RF detectors, SWR bridges, or other devices.

The function of the POWER SWITCH is to switch off the DC power to the RF module during a portion of the retrace time. This is accomplished by a blanking signal from the trigger circuit which turns off the RF output. (The retrace line is used as the zero-reference on the CRT face.)

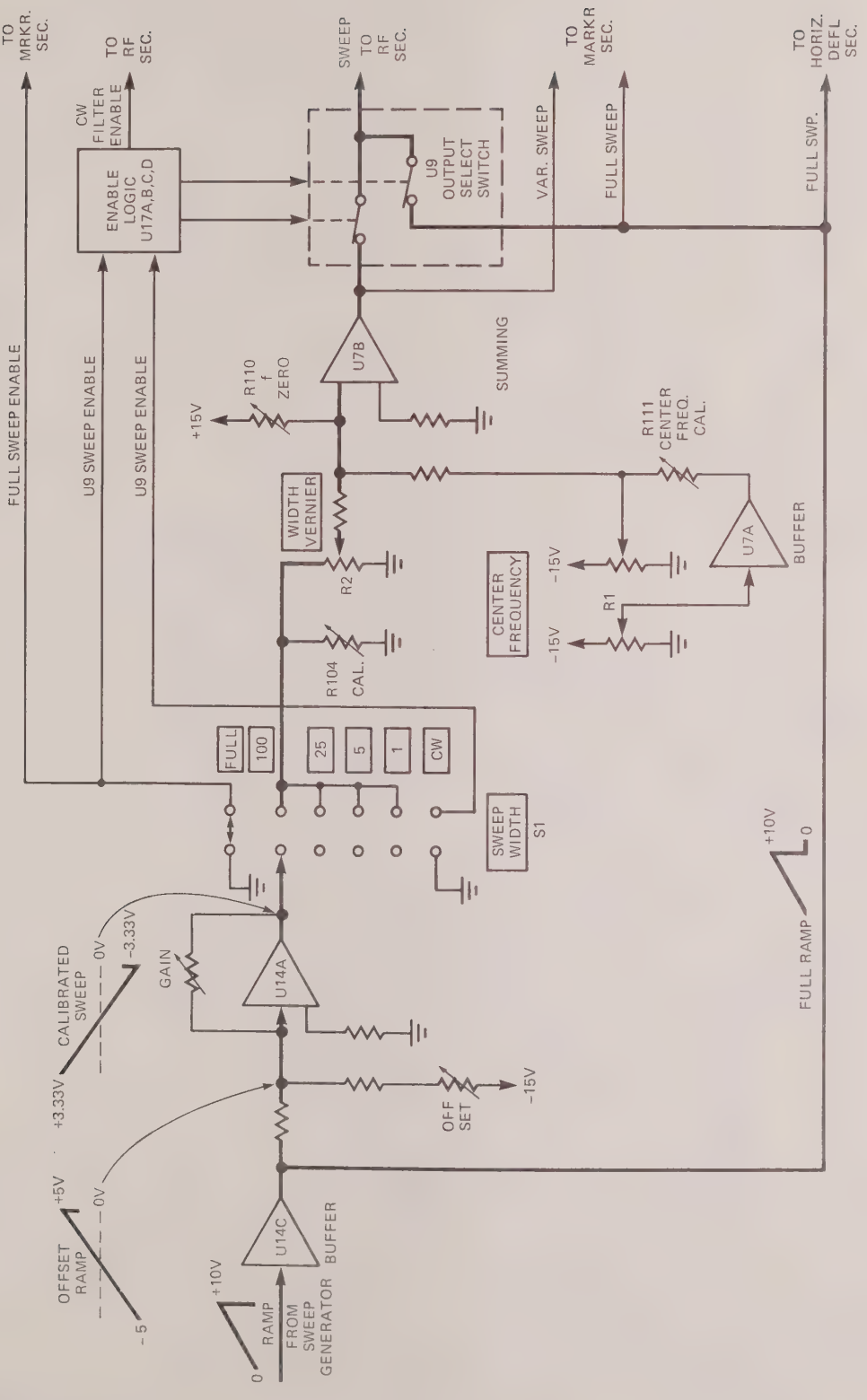


Figure 3-3. Frequency Instruction Circuits

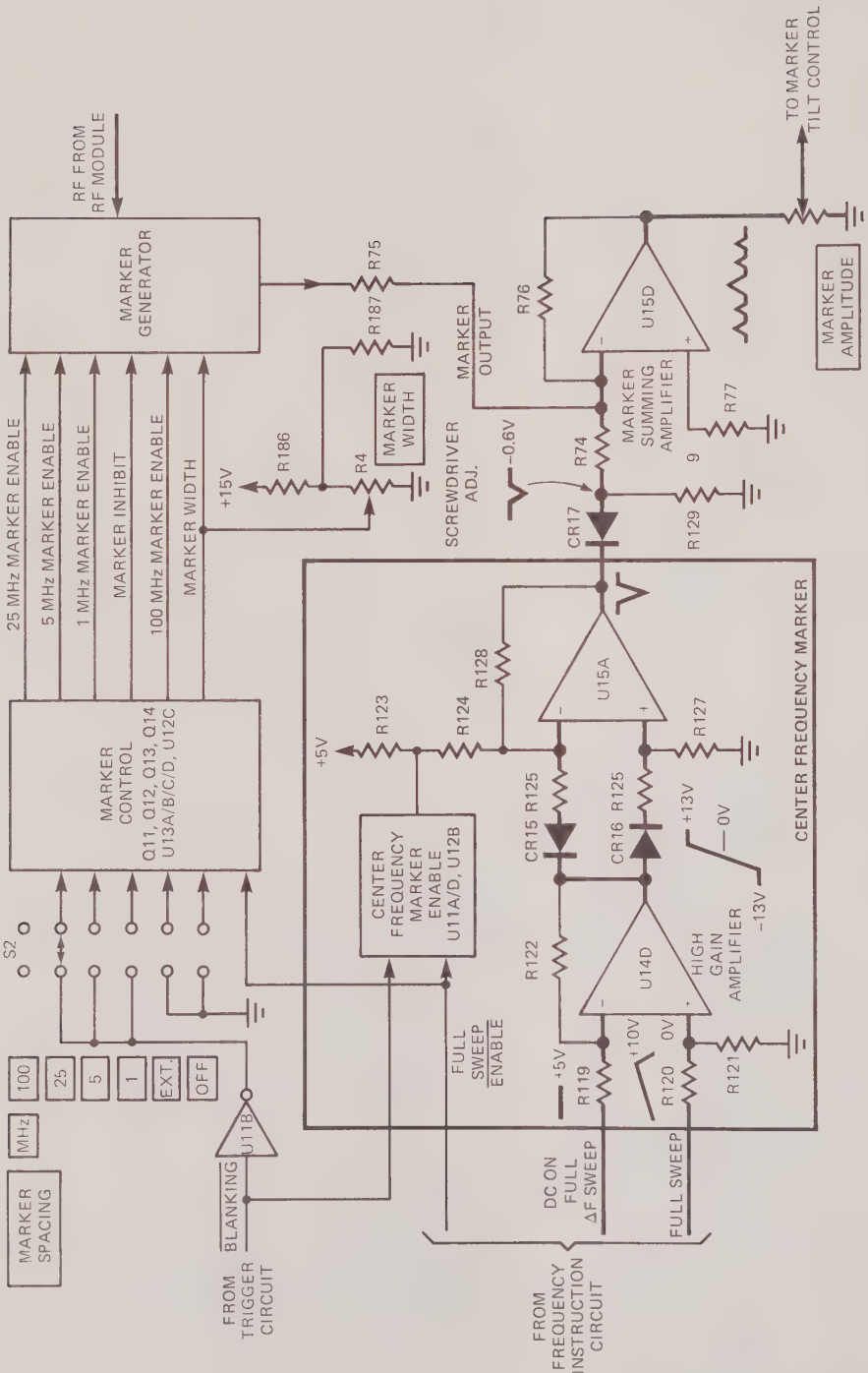


Figure 3-4. Marker Generation and Control, Simplified Diagram

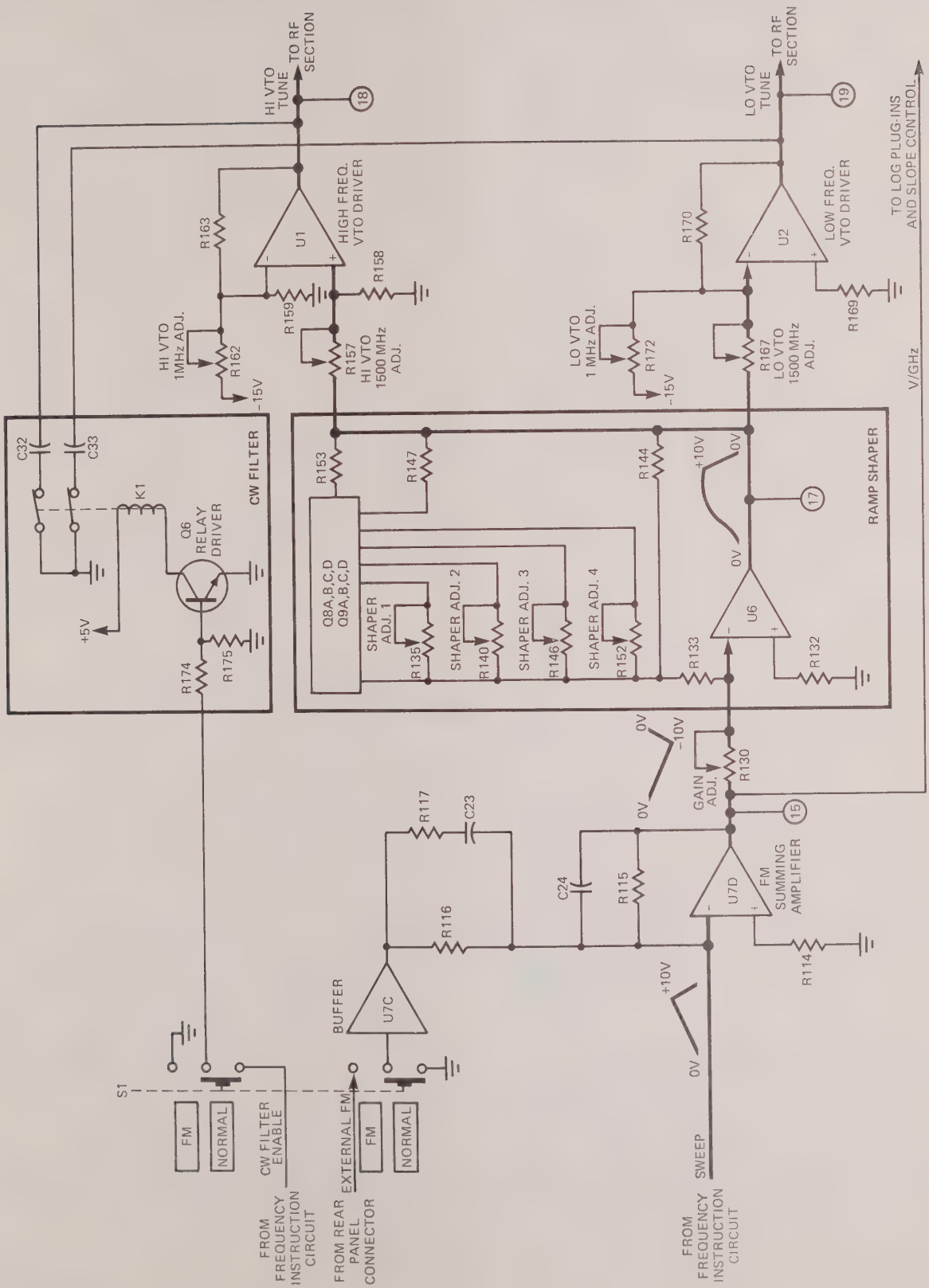


Figure 3-5. Ramp Shaper Circuits, Simplified Diagram

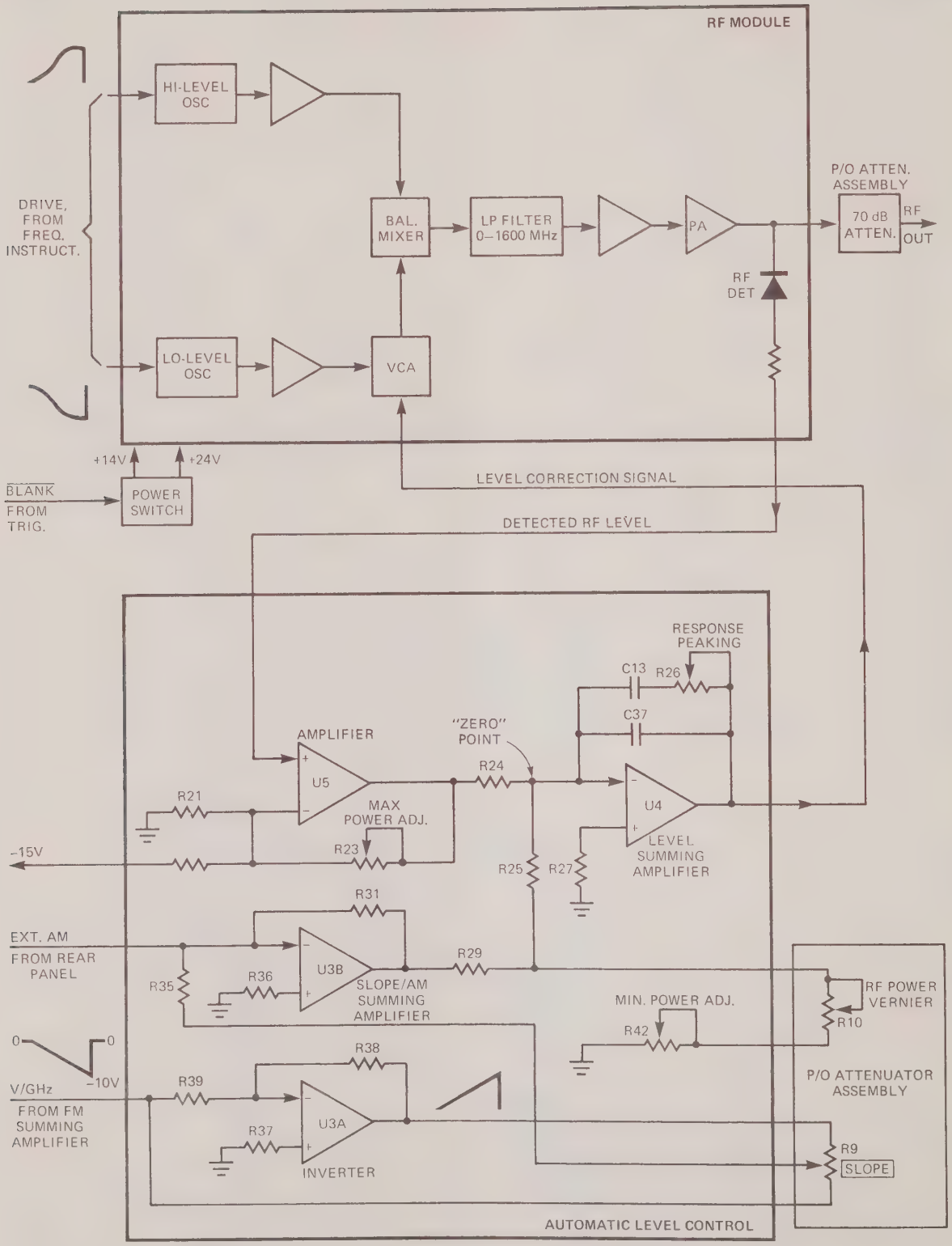


Figure 3-6. RF Module and AFC Loop

3-3.5 Horizontal Deflection

The inputs to the Horizontal Deflection section (refer to Figure 3-2) are the full ramp (from the Frequency Instruction section) and the markers. These two are summed, amplified, and directed to the horizontal input of the main frame. The full ramp provides the horizontal deflection voltage; the markers are added to provide marker-tilt for easy identification of markers on portions of traces having very steep slopes.

The marker pips from the marker section are applied to the MARKER TILT (front panel) control. Each end of the control is applied to the non-inverting inputs of U15B and U15C. As these amplifiers are cascaded, this introduces negative-going or positive-going "pips" into the horizontal deflection voltage, depending upon to which end of the potentiometer the MARKER TILT control is set. As these voltages occur at the same instant on the vertical deflection trace (from the log. amplifier outputs), the vector addition or summation is a marker which can lean to the right or left or be exactly vertical, depending upon the setting of the MARKER TILT control. (When the TILT control is in the center, the negative and positive markers cancel each other and the result is no tilt.)

3-4 LOG. AMPLIFIER PLUG-INS

Figure 3-7 shows the major sections incorporated in three different models of Log. Amplifier Plug-Ins used with the Model 640 RF Analyzer. These are:

1. RF Component (front end)
2. Preamps and Log. Conversion
3. Summing Amplifiers and Filters
4. Gain/Offset Section
5. Marker Summing Amplifiers

The major difference among the three models of log. amplifiers is in the front end. The Model 640T Log. Transmission Plug-In uses an RF Detector; the Model 640R Log. Reflection Plug-In incorporates an SWR Autotester (an SWR Bridge with built-in RF detector); the Model 640E Log. Amplifier has no internal RF components but relies on the use of external RF detectors or SWR bridges.

Since both the Model 640T and 640R have internal RF components, their input is an RF signal representing a scalar reflection or transmission measurement. This input is then converted into a proportional DC signal, suitable for input to the OP amplifier, U1. The input to the Model 640E Log. Amplifier is a similar DC signal from the external RF component.

With all three models, the output is a DC signal, proportional to the log. of the input RF power and suitable for driving the vertical input of the CRT display.

3-4.1 RF Components

Figure 3-8 shows the internal wiring of the RF detectors (A) and SWR Autotesters (B) used with the Model 640 RF Analyzer. When the RF detector is built into the Model 640T Log. Transmission Plug-In, the RF INPUT connector is mounted on the front panel. If the same detector is used externally with the Model 640E Amplifier, the front panel connector has five pins: two leads carry the negative-polarity signal from the RF detector; two leads conduct thermistor current (used by the amplifier to correct for temperature shifts); and the fifth wire is used for a ground shield.

It should be noted that the external detectors come with a built-in CAL resistor. It connects to pin 4 of the front panel connector, and this is the configuration used with the Model 640E Log. Amplifier. In the detector used with the Model 640T, the CAL resistor is mounted internally to the amplifier, and the detector is wired to pin 5. This adjustment of the CAL resistor is made with an input signal of 0 dBm, using a calibrated reference, and provides a highly accurate power calibration.

When the SWR Autotester (Figure 3-8B) is incorporated into the front end of the Model 640R Log. Reflection Plug-In, there are two front panel connectors: the RF INPUT and the TEST PORT. These connect to the RF output from the sweep generator and the input port of the test device, respectively. Note that the same pin connections are used for detector current and thermistor current for both the Model 640T and 640E Plug-Ins.

3-4.2 Preamps and Log. Conversion

The preamplifier (see Figure 3-7) consists of the operational amplifiers U1, U5, U7, and U10, plus transistor Q13, which acts as a buffer and provides current drive for the last 3 stages. During the initial setup, the INPUT REF. VOLTAGE is adjusted to provide an exact zero. Each Op amplifier (see detail, Figure 3-9) is then

adjusted, the zero potentiometer balancing each output to 0V. The 2.7V limiters limit the output of each stage to 2.7 volts, preventing overdrive of the log. conversion module which follows.

The inputs to the Log. Conversion Module (Fig. 3-7) are four log. windows, each taken from the output of a different Op amplifier stage. Each preamplifier stage saturates in sequence: the last one (U10) first; then U7, then U5 and, finally, U1. Each log. window thus represents a range of RF power for log. conversion.

The output of the Log. Conversion Module can be either a negative or a positive voltage, proportional to the logarithm of the RF input signal.

3-4.3 Summing Amplifiers and Filters

The output of the Log. Conversion module is input to summing amplifiers U3A and U3B, where it is combined with the following signals:

a) a ramp voltage (V/GHz) from Sweep Generator plug-in - The ramp can be adjusted by the DETECTOR SLOPE potentiometer to produce either a negative or positive ramp, to compensate for the frequency characteristics of the diode in the RF detector.

b) the thermistor current (from the RF front end) - This current compensates for shifts in RF detector output which occur with temperature change.

c) a DC voltage from the OFFSET dB potentiometer which compensates for any DC offset produced in the summing section.

The SMOOTHING control has three positions: MAX, MIN, and OFF. The first two positions select integrating capacitors to reduce the large amount of noise in the trace when the signal is -40 dBm or less. The 100 mV/dBm control is used to calibrate the gain of all stages up to and including U3A and U3B. The OUTPUT GAIN control is used to calibrate the gain of the final stages.

3-4.4 Gain/Offset Section

This section consists of amplifiers U12 and U9, plus the following controls.

dB/DIV (S5): Provides calibrated gain settings of 10, 5, 2, 0.5, and 0.2 dB per division of vertical graticule on the CRT display screen. On the Model 640R, the 0.2 position is omitted.

OFFSET dB (R62): Calibrated potentiometer which reads in tenths of dB, dB, and tens of dB. Introduces a negative or positive voltage output from U9 which is summed with the signal in U12 to produce an accurate offset ranging from 0 to 90 dB.

OFFSET + - (S3): Selects polarity of offset voltage. The DIAL TRACKING adjustments calibrate the OFFSET dB control independently for - or + voltage.

ZERO dB SET (R94): Used to independently vary DC offset, to establish a zero dB reference relative to the retrace base line.

dBm/dB (S4): In the dBm position, the ZERO dB SET control is disabled and the log. amplifier becomes a direct-reading power meter. This switch is omitted on the Model 640R Log. Reflection Plug-In.

ON (S6): In the Off position, this switch eliminates the signal trace, leaving only the reference line (retrace base line).

3-4.5 Marker Summing Amplifiers

The signal input to U15A is summed with markers from the Sweep Generator plug-in to produce the composite signal for the vertical output. Negative-true blanking pulses, also from the sweep generator, switch off Q12 and blank the output during retrace. As the retrace itself is not blanked, this supplies a true reference line. The retrace line is positioned by means of the DISPLAY POSITION control.

3-5 LINEAR AMPLIFIER PLUG-IN

Figure 3-10 is a simplified diagram of the Model 640L Linear Amplifier Plug-In. This amplifier is provided for those who prefer a linear to a logarithmic display. It gives display sensitivities as high as 1mV per division. A calibrated OFFSET, mV control permits the user to view any signal from 1mV to 1V, while retaining maximum sensitivity and the vertical voltage calibration.

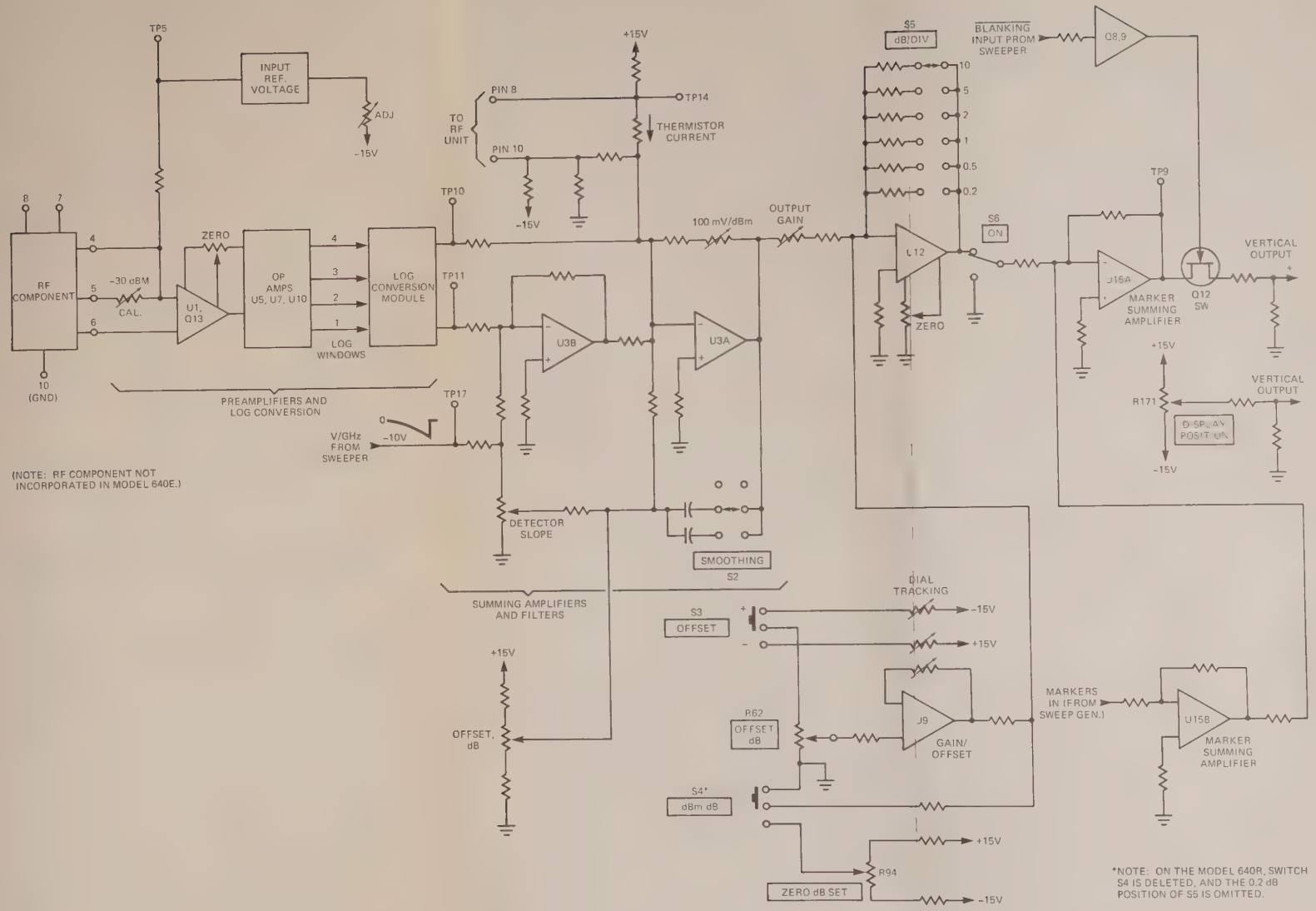


Figure 3-7 Model 640T, R, and E, Log. Amplifier Plug-Ins, Block Diagram

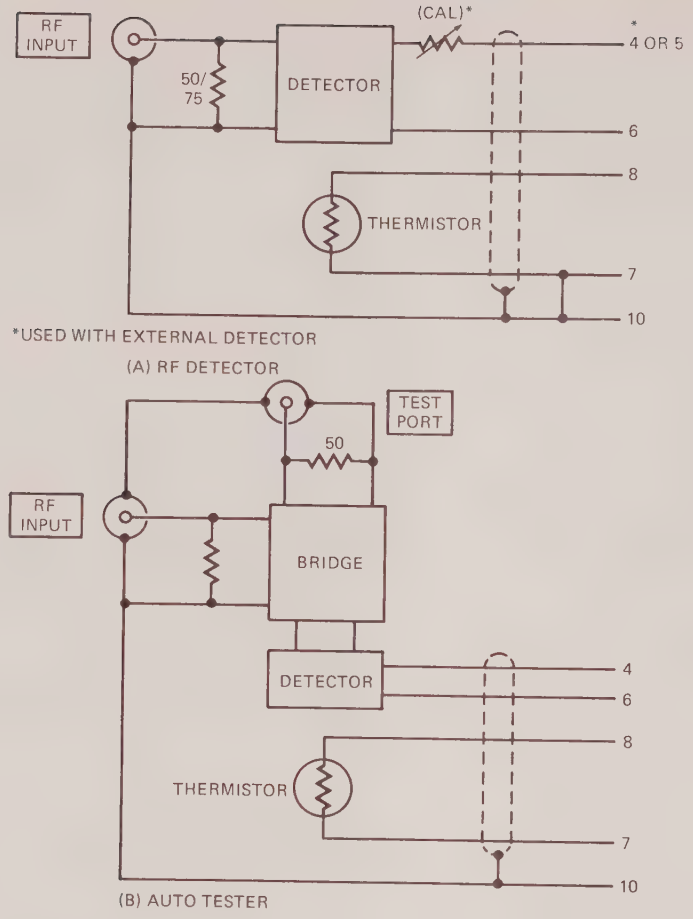


Figure 3-8. RF Components for Log. Amplifier Plug-Ins

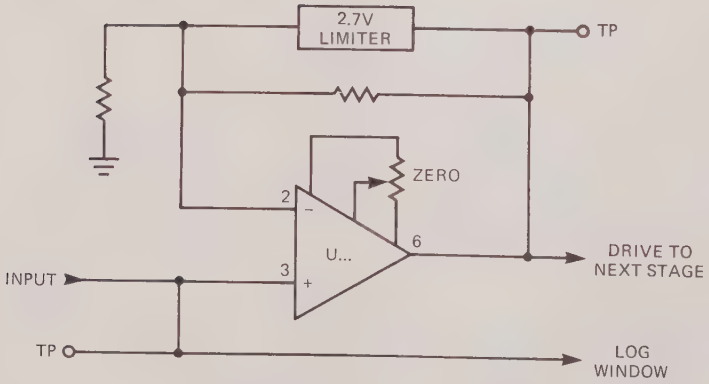


Figure 3-9. Detail, Typical Op-Amp Stage

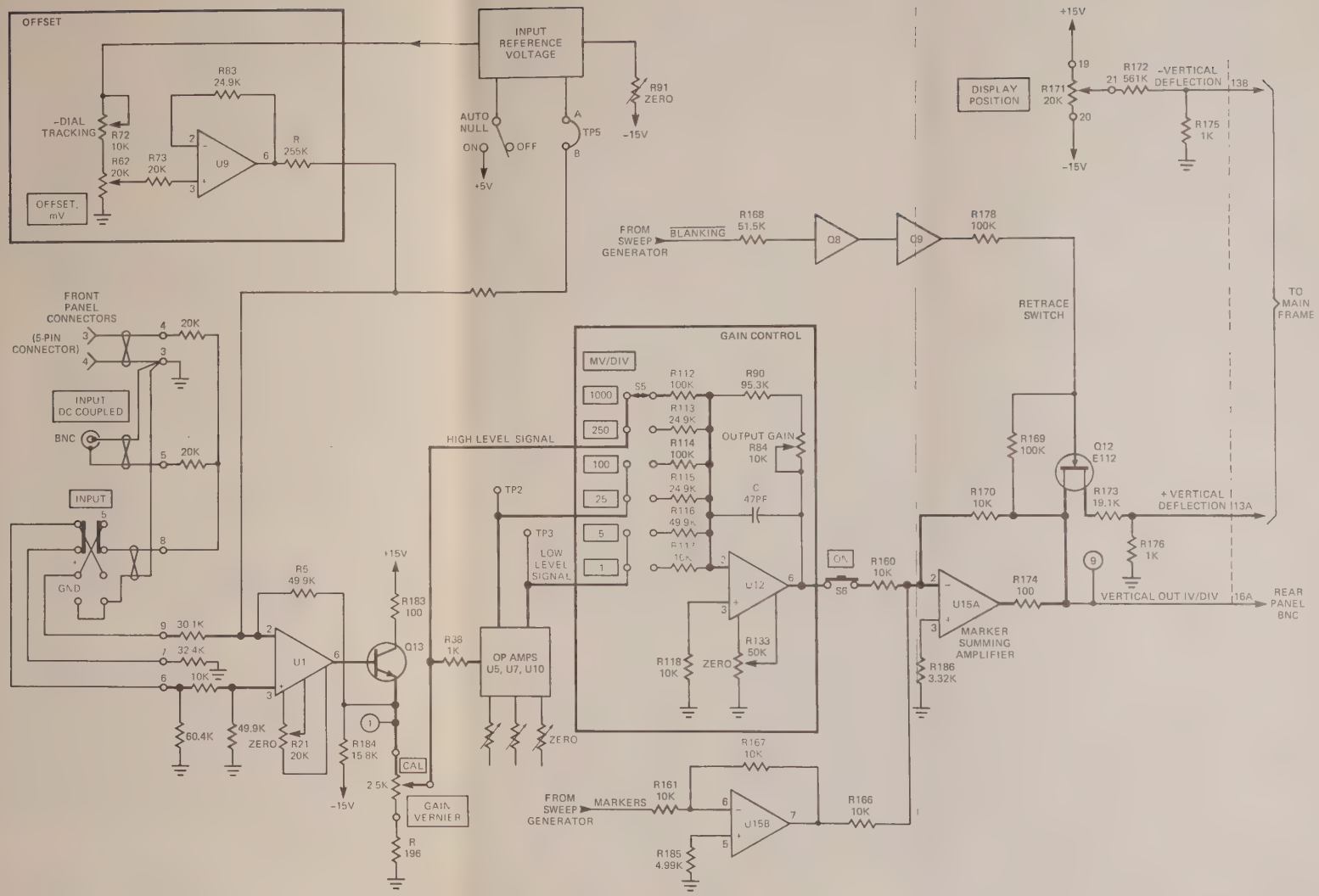


Figure 3-10 Model 640L Linear Amplifier

The DC input signal can be applied either to a 5-pin connector (for WILTRON Series 6 or Series 7 RF components) or to a standard BNC connector, if the amplifier is used with other types or makes of components. The INPUT switch at the front end will select either a positive or a negative signal. Since the WILTRON Series 6 and 7 RF components have negative outputs, the user should select a negative signal for these components. The switch connects the input to the inverting or non-inverting input to U1 and grounds the other pin. This signal is then summed with the output of U9, permitting it to be offset by means of the OFFSET, mV switch (R62).

The offset voltage is also summed with an initial zero-set or input reference voltage. The AUTO NULL switch can be turned on to eliminate the effects of a constant-level DC signal, such as obtained from a detected L.O. RF signal. This switch can be accessed only by removing the plug-in from the main frame.

The Amplifier section has four stages--U1, U5, U7 and U10--with transistor Q13 acting as a buffer-driver for the last three. The zero adjustments are used, under conditions of no signal input, to balance the output of each stage to 0V. The GAIN VERNIER, when not in the CAL (detent) position, allows the user to "expand" the display vertically for convenient viewing. It should be noted three different levels of signals are tapped from the amplifier stages and directed to the GAIN CONTROL section.

The mV/DIV switch (S5) forms, with resistors R112 through R117, the means for calibrating scale sensitivities ranging from 1mV to 1000mV in six steps. The OUTPUT GAIN control for U12 is used to calibrate the gain for all stages in the amplifier.

U15A sums the signal with markers from the sweep generator to produce the composite signal for the vertical output. Switch Q12, operated by negative-true blanking signals (also from the sweep generator plug-in), eliminates the signal and the markers during retrace. As the retrace is not blanked, it acts as a true reference baseline, and is positioned by means of the DISPLAY POSITION control. The ON switch, when in the Off position, removes the signal trace, leaving only the retrace reference on the CRT screen.

3-6 MAIN FRAME (CRT DISPLAY)

The main frame, which holds the three plug-in units, is also a high-quality dual-channel oscilloscope. It is manufactured for WILTRON Company by Tektronix. Although it may superficially resemble other Tektronix scopes, it will not accept any of the Tektronix plug-in units (nor will WILTRON plug-ins for the Model 640 work in a Tektronix scope).

Figure 3-11 is a simplified diagram of the Model 640 Main Frame, showing the major elements. In addition to the CRT, the main frame contains the four PC boards described below:

A1 - High-Voltage Deflection Board. This contains the horizontal and vertical deflection amplifiers, the Z-axis (intensity) amplifier, and the high-voltage supply for the CRT. The signal inputs are the horizontal and vertical signals from the amplifiers on the A3 board. The signal outputs go to the horizontal and vertical deflection plates in the CRT.

A2 - Auxiliary Board. This contains the switching circuits which enable two vertical input signals (from the log. plug-in units) to time-share one vertical channel. The switching action is timed by clock signals from the A3 board. The output is a push-pull signal to the vertical amplifier on the A3 board.

A3 - Interface Board. The A3 board provides the interface connectors for the three plug-in units. It contains, in addition to the clock and countdown circuit for the A2 board, vertical and horizontal amplifiers to drive the deflection amplifiers in the A1 board. The input to the horizontal amplifier on the A3 board is the sweep ramp from the Model 640G Sweep Generator plug-in. Two other sub-components are the Voltage Drop Assembly and the Pen-Lift (option) assembly.

A4 - Low-Voltage Power Supply Board. This contains the low-voltage rectifiers and regulators for all circuits in the main frame and the plug-ins. (Note: the plug-ins also contain internal regulators, but these are driven by DC voltages supplied from the A4 board.)

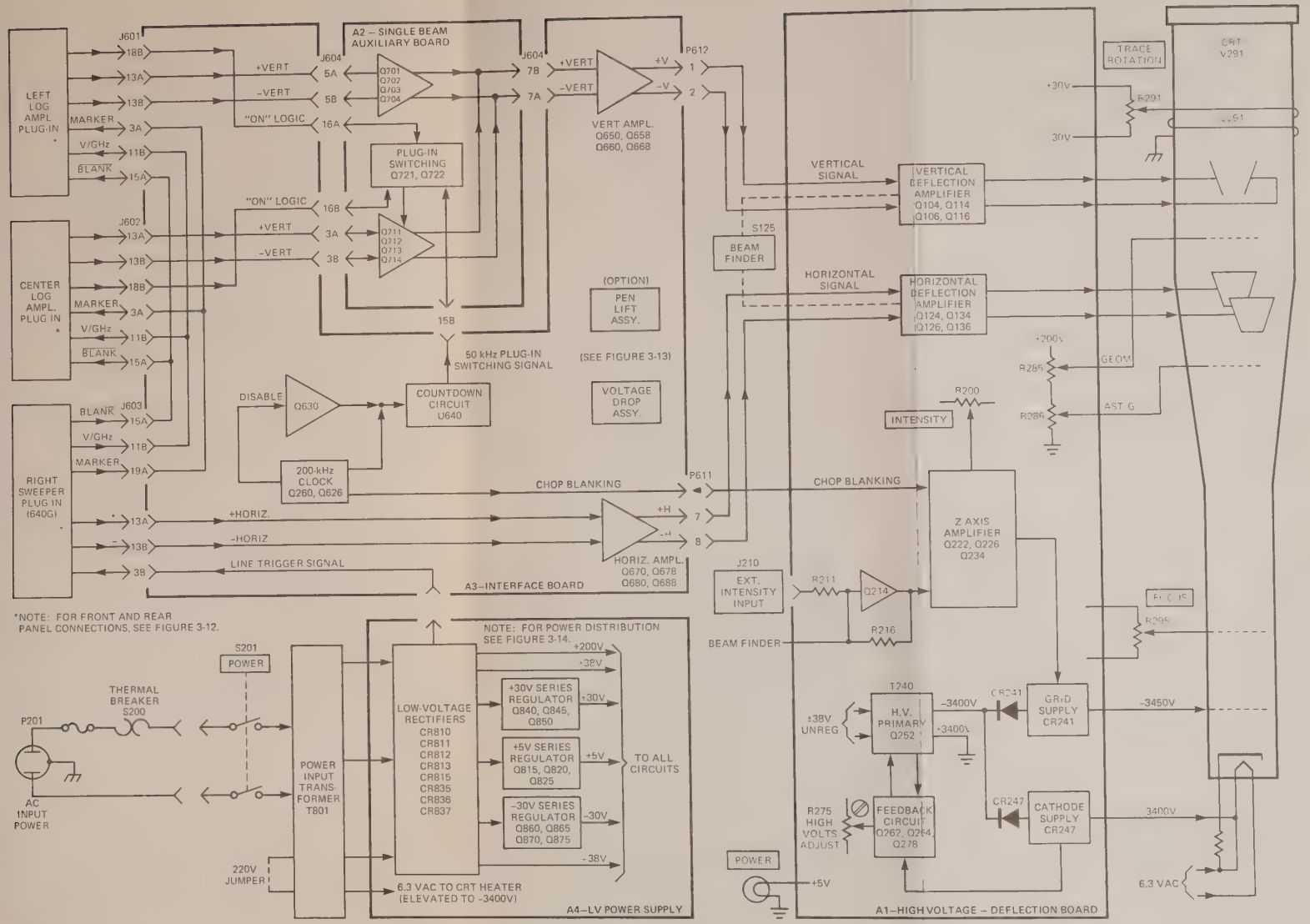


Figure 3-11 Mainframe, Block Diagram

3-6.1 A3 Interface Board

The vertical input signals, coming from the log. amplifiers, connect through pins 13A and 13B of both J601 and J602. The vertical signals are then passed through the A2 board, where they are chopped at a 50-kHz rate. The switcher on the A2 board is enabled by hard-wired "on" logic (activated when either log. amplifier unit is plugged in). The chopped output from the A2 board is then directed through J604 to the vertical amplifier (Q650, Q658, Q660 and Q668) on the A3 board. The dual-channel signals are amplified about 10 times before being passed on to the vertical deflection amplifier on the A1 High-Voltage Deflection Board.

The A3 board is also the interface between the sweeper and the log. amplifier plug-ins. The signals directed to the amplifiers are the markers, the V/GHz DC ramp voltage, and the negative-true blanking signal. The functions of these signals have been previously described (paragraph 3-4).

The horizontal input signal to the A3 board is the sweep ramp from the sweeper plug-in. This signal is directed to the push-pull input of the horizontal amplifier (Q670, Q680, Q678 and Q688) on the A3 board. This amplifier is essentially identical to the vertical amplifier. The A3 board connects a 60 Hz LINE TRIGGER SIGNAL from the A4 board to the sweep generator. It also connects the CHOP BLANKING signal from the 200 kHz switching clock to the CRT. It should be noted that the CRT is not blanked during retrace (this line establishing the reference trace); the chop blanking signal is used to eliminate transients resulting from the switching action.

The A3 board also acts as an interface between the plug-ins and the front and rear panels of the Model 640 RF Analyzer (see Figure 3-12). The vertical trace from both log. amplifiers is available at rear panel BNC connectors LEFT OUT and CTR OUT. Markers from the sweep generator are fed to the log. amplifiers through the front panel AMPL control. The same markers are returned to the sweeper via the front panel TILT control. The action of mixing the markers with the horizontal deflection ramp has already been described. Note that the horizontal ramp voltage is made available at a rear panel BNC connector (HORZ OUT). The external trigger, external FM, and external AM signals are also applied to the sweep generator through rear panel BNC connectors.

The function of the Pen Lift Assembly (see Figure 3-13A) is to provide a means by which an external pen recorder will record only during trace, or when the sweep rate is slow. This is done by means of a relay closure, accessed through the rear panel PENLIFT BNC connector.

The $\overline{\text{BLANKING}}$ signal comes from the sweeper and is negative during trace, turning on Q101 and causing Q102 to conduct, thus energizing the relay. During retrace the same signal is high, and both Q101 and Q102 are off. The relay is then de-energized and the contacts open. Contact closure is prevented by the PEN LIFT INHIBIT signal, which is at ground potential when either FAST sweep or MANUAL sweep rate is selected.

The function of the Voltage Drop Assembly (Figure 3-13B) is to provide a +24V for the RF Section in the sweeper. This and the +14V (from the sweeper regulators) are switched off during a portion of the retrace. This latter action is internal to the sweeper, however.

The Voltage Drop Assembly also provides a +18V and -18V unregulated for the 15V regulators in the sweeper. The two 18V sources are derived from the ±30V source through R1 and R2, respectively.

3-6.2 A2 Auxiliary Board

The two log. amplifiers (see Figure 3-11) are able to time-share the one vertical channel because the amplifiers in the A2 board are switched on alternately at a high (50 kHz) rate. Switching is controlled by Q721 and Q722. The switching signal comes from the Countdown Circuit (U640) on the A3 board. The same clock (Q620, Q626 on the A3 board) that generates the chopping signal also sends the CHOP BLANKING signal to the CRT.

3-6.3 A1 High-Voltage Deflection Board

The vertical deflection amplifier obtains its input from the vertical amplifier in the A3 board. Q104, Q106, Q114, and Q116 are connected in a differential configuration, and provide a push-pull output sufficient to drive the vertical deflection plates in the CRT. The amplification is about 50 times. The horizontal deflection amplifier (Q124, Q126, Q134 and Q136) is essentially identical to the vertical deflection amplifier. Its input is the sweep ramp from the horizontal amplifier on the A3 board.

Model 640

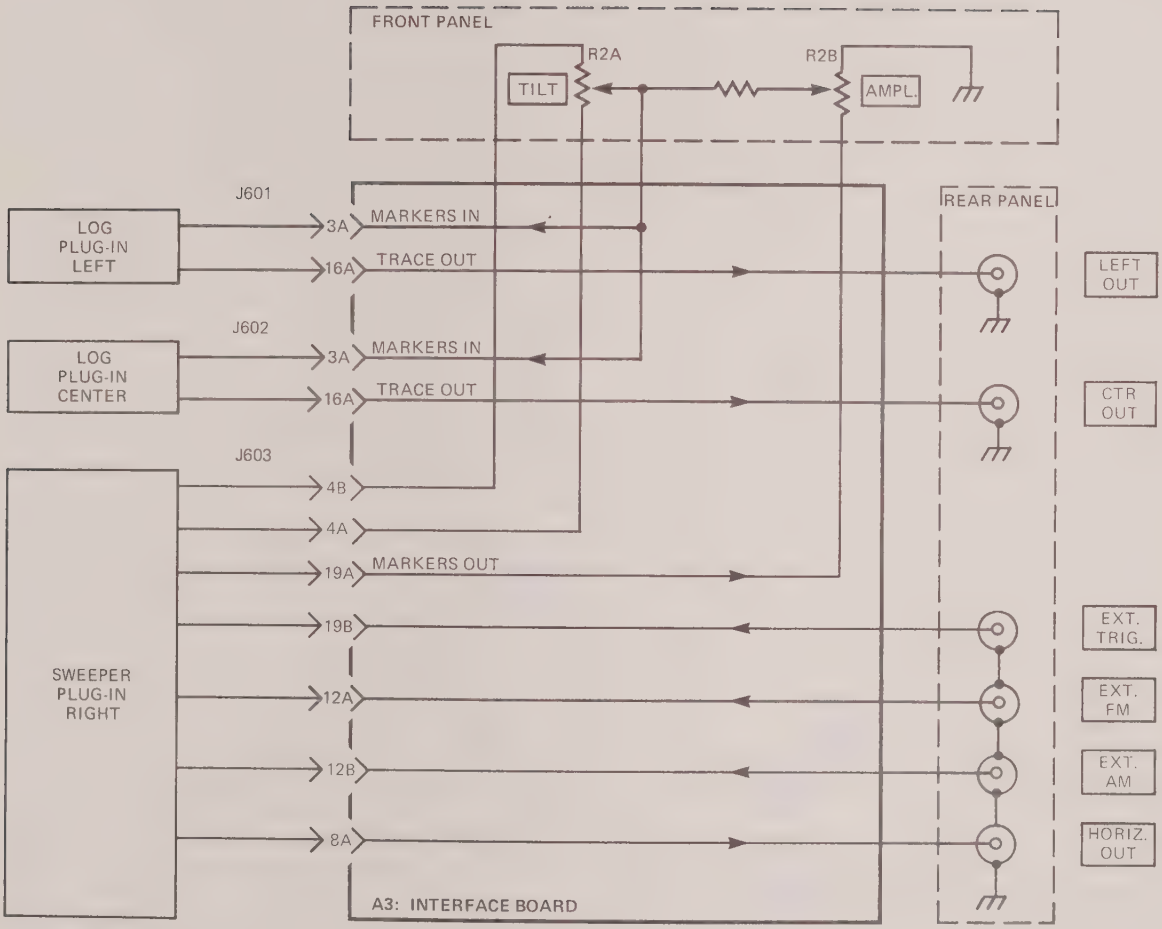


Figure 3-12. Front Panel and Rear Panel Connections from Plug-Ins

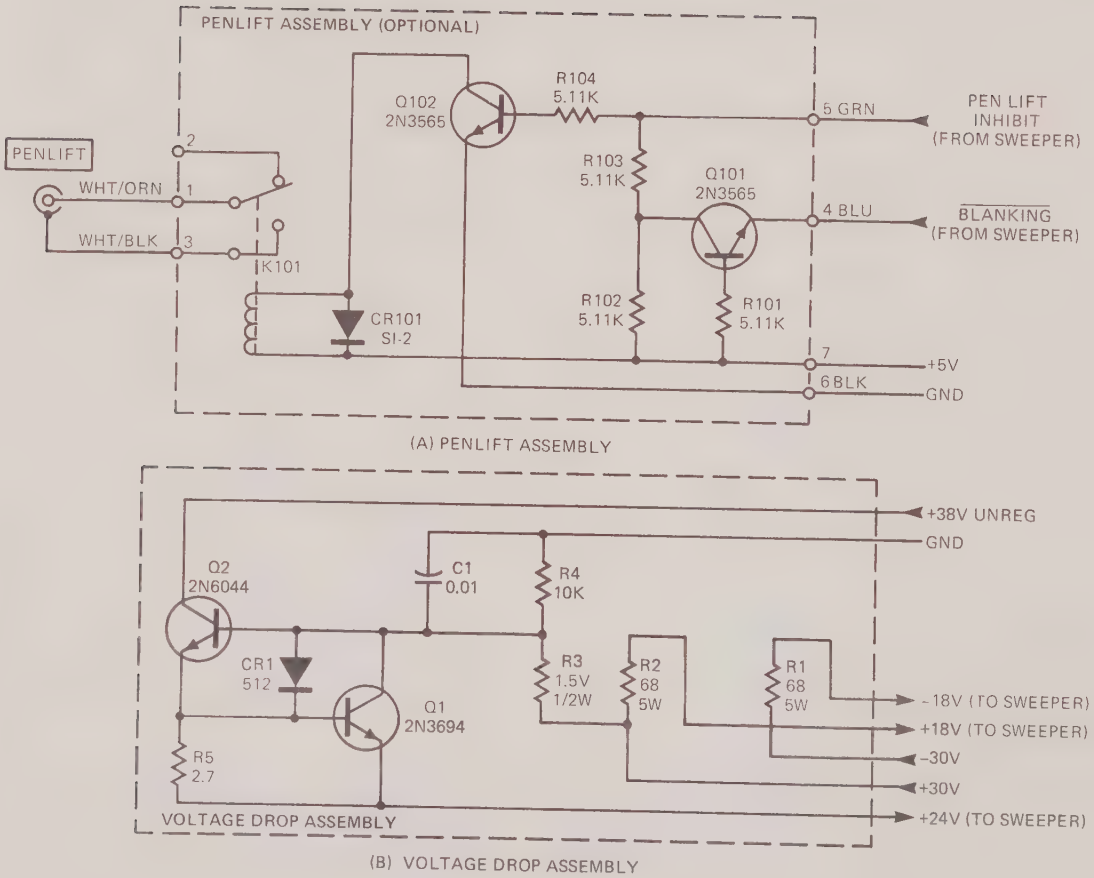


Figure 3-13. Interface Board, Detail

Model 640

The inputs to the Z-Axis amplifier (Q222, Q226 and Q234) are the CHOP BLANKING signal from the A3 board, the EXT INTENSITY INPUT (J210) from the rear panel, and an input from the BEAM FINDER. The output of the Z-axis amplifier goes to the Grid Supply of the CRT and is used to modify the intensity of the electron beam. The front panel BEAM FINDER pushbutton, when pressed, limits the emitter current of both the vertical and horizontal deflection amplifiers; thus it limits the dynamic range of the signal to a level which will remain on-screen, even with excessive input levels or mis-adjusted controls. This button also increases the intensity of the CRT beam, allowing the trace to be seen even if the INTENSITY control is fully CCW.

The -3400V acceleration HV for the CRT is developed by the HV primary of T240, which is pulsed by transistor Q252. Q252 is turned on by positive feedback from the primary of the transformer, and turned off by the switching action feedback from Q262 and Q264. Q278 acts as a gate, sampling an AC voltage from another winding of T240 to determine conduction time and thus regulate the high-voltage output. DC feedback from the cathode supply is also summed in the gate input to provide a high order of regulation.

Note that there are two high-voltage outputs. CR247 develops the -3400V acceleration voltage, which is applied between CRT cathode and ground; the half-wave rectifier CR241 develops -3400V to bias the control grid. The final voltage on the grid is determined by the Z-axis amplifier and by the setting of the front panel INTENSITY control.

FOCUS, GEOM (geometry), and ASTIG (astigmatism) controls are also provided. Of these, only the FOCUS control is on the front panel. The rear panel TRACE ROTATION control (R291) permits adjustment of the DC current through beam-rotation coil L291 and aligns the display trace with the CRT's horizontal graticule lines.

3-6.4 A4 LV Power Supply Board

The Low Voltage (LV) Power board supplies the DC power for all boards in the main frame as well as in the three plug-ins. Power input is single-phase AC, 110V or 220V, 48 to 440 Hz. Note that AC power is applied through a fuse, power switch, and thermal breaker. The secondary of power input transformer T801 feeds the full-wave bridge rectifiers, which in turn feed filters or series regulators. Note that there are two unregulated DC output voltages and three regulated DC output voltages. Figure 3-14 shows the DC power distribution as well as which voltages are used by which units.

In addition to the +5V regulated source and the ±30V source, the log. amplifier plug-ins also require a +15V and -15V regulated DC. These are generated internally from the +30V and -30V source. The sweep generator plug-in requires a +15V and -15V regulated DC, and the RF Section a +24V and +14V. The ±15V are generated from the ±30V input by internal regulators, and the ±18V from the Voltage Drop Assembly. The +24V DC is supplied also from the Voltage Drop Assembly, and is derived from the +38V unregulated source. The +14V is derived internally from the +15V regulated source.

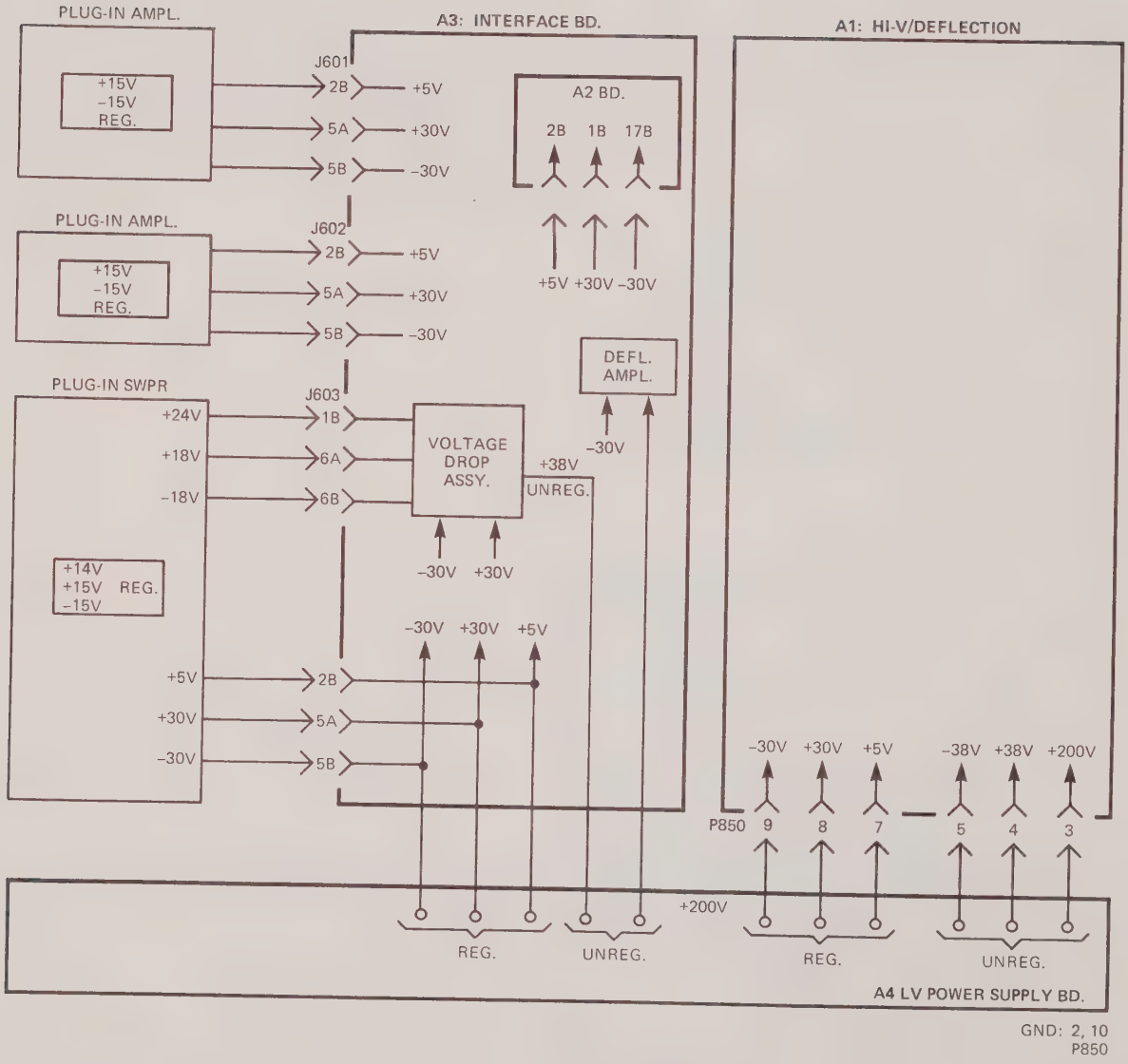


Figure 3-14. DC Power Distribution

SECTION IV
MAINTENANCE

4-1 INTRODUCTION

This section contains a list of recommended test equipment, some quick procedures for checking the system's operational status, plus detailed instructions for making adjustments and for verifying system performance and accuracy. A set of troubleshooting charts are also included in this section. Other troubleshooting aids such as schematics, waveforms, and voltage levels are found in Section VI.

4-1.1 Recommended Test Equipment

The test equipment listed in Table 4-1, or its equivalent, is sufficient for troubleshooting and adjusting the Model 640 RF Analyzer. The specifications for this equipment is the minimum necessary for accurate results.

4-1.2 Corrective Maintenance

Replacement of parts may effect the accuracy of the Model 640 RF Analyzer. After replacing any parts, check the performance, making any necessary adjustments to insure that the system performance has not been degraded.

4-1.3 Incoming Inspection

For incoming electrical inspection, initialize the system as shown in Table 2-1 (Section II), and use the example measurement (paragraph 2-4.1) or any of the operating instructions (paragraph 2-4.2 through 2-4.5) to determine that all components and controls are working properly.

4-2 PERFORMANCE VERIFICATION

Paragraphs 4-2.1 through 4-2.4 contain procedures designed to return the performance of the Model 640 RF Analyzer to specified capabilities and accuracy. These checks and adjustments are normally required only following a circuit repair, when some component has been replaced, or after a long time interval during which normal aging may affect the accuracy.

CAUTION

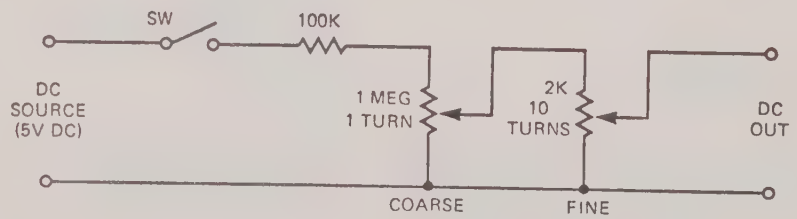
DO NOT MAKE ANY ADJUSTMENTS IN THIS PROCEDURE UNLESS THE TEST RESULTS ARE DEFINITELY OUT OF TOLERANCE AND YOU ARE CERTAIN THAT THE CHECKS WERE PERFORMED PROPERLY.

It should be noted that many of these adjustments will affect the accuracy or performance of other circuits. In general, the technician should verify the readings, and not make any adjustments unless a value is clearly out of limits. The exceptions to this rule are clearly identified, and occur where any adjustment will necessitate recalibration of following sections. In particular, these procedures should not be performed by anyone but a highly qualified technician.

These procedures should not be used as a troubleshooting guide. However, any troubles noted during the procedure must be corrected before continuing (see paragraph 4-3).

Table 4-1. Recommended Test Equipment

DESCRIPTION	MANUFACTURER
Power Meter	HP 435A
Power Sensor (50 ohm)	HP 8481A
Power Sensor (75 ohm)	HP 8483A
Digital Multimeter	Fluke 8600A
High Voltage Probe	Fluke 80
Oscilloscope, mainframe	Tektronix 5440
Time Base	Tektronix 5B10N
Differential Amplifier	Tektronix 5A22N
Attenuator (50 ohm) (0 to 60 dB, in 10 dB steps, variable 0-10 dB)	Weinchel 908-70
Frequency Counter (1 MHz to 1.5 GHz)	EIP 350D
RF Detector (50 ohm)	Wiltron 7N50
(75 ohm)	Wiltron 7N75
Extender Cable	Wiltron 640-ML-5282
Fixed Voltage Source (5 V to 9 V, 0.001A drain)	-----
Test Fixture	See drawing below



All resistors and pots, 1/4W.

4-2.1 CRT and Mainframe Checks

CAUTION

DO NOT MAKE ANY ADJUSTMENTS IN THIS PROCEDURE UNLESS THE TEST RESULTS ARE DEFINITELY OUT OF TOLERANCE AND YOU ARE CERTAIN THAT THE CHECKS WERE PERFORMED PROPERLY.

NOTE

For best overall accuracy, the instrument should be operating at an ambient temperature of 20°C to 30°C.

1. System Preparation

A. Remove the right, left and bottom panels of the Model 640 mainframe.

B. Insert the two amplifier plug-ins and the sweep plug-in.

C. Connect the mainframe to the power source.

D. Set the controls as follows:

INTENSITY	CCW *
FOCUS	Midrange
MARKER AMPL	CCW *
POWER	ON

*In this procedure, CCW indicates fully counter clockwise, and CW fully clockwise.

2. Check and Adjust Power Supplies

A. Connect the DC voltmeter between each low-voltage test point and ground (see Figure 4-1).

B. Check that each supply is within tolerances listed as follows:

Supply	Tolerance
-30 V	-29.05 to -30.975 V
+5 V	+4.75 to +5.25 V
+30 V	+28.95 to +31.07 V
+200V	+175 to +247.5 V

C. If the -30 V or +30 supplies are out of tolerance, adjust R878 and R858 (see Figure 4-2). These voltages affect all other adjustments.

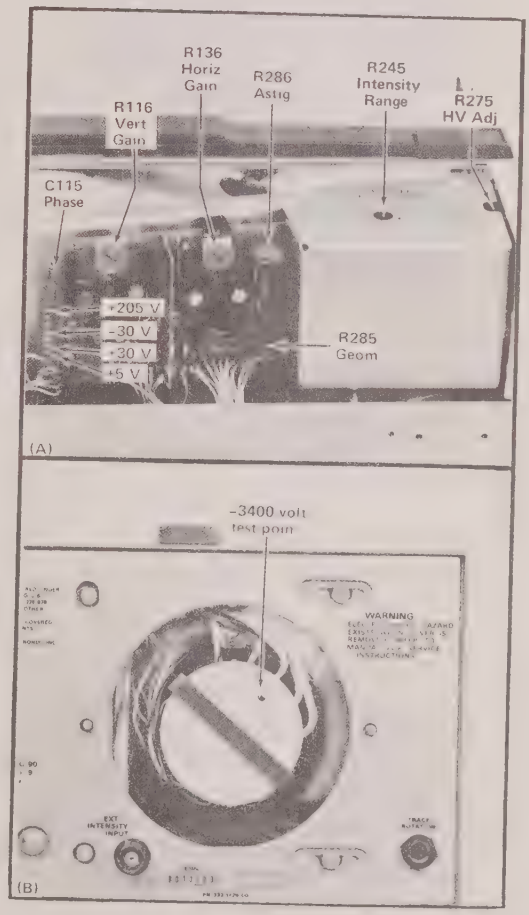


Figure 4-1. Voltage Test Points, Gain, Astigmatism, Intensity, and Other Adjustments

CAUTION

Turn off instrument power when connecting and disconnecting HV DC probe.

D. Connect the high voltage probe to measure between the -3400 V test point and ground.

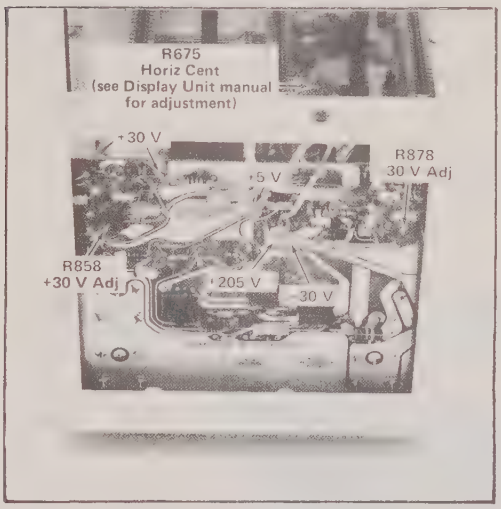


Figure 4-2. Locations of Low Voltage and Horizontal Centering Adjustments

E. Reading should be -3400 V ± 170 V.

F. If out of tolerance, adjust R275 HV ADJ (see Figure 4-1).

3. Check and Adjust the CRT System

A. Remove the center Model 640E Log. Amplifier Plug-in (if system has both the Model 640R and 640T log. plug-ins, remove the Model 640R plug-in). Set the sweeper and log. amplifier plug-in controls as follows:

Model 640G:

CENTER FREQUENCY	500 MHz
MARKER SPACING	OFF
SWEEP WIDTH	FULL
SWEEP RATE	FAST
Vernier	CW (clockwise)
TRIGGER	AUTO
WIDTH VERNIER	CAL
RF OUT dBm	-20.0 dBm
Vernier	(at 3 o'clock)

Model 640T, R, or E:

OFFSET ±	+
OFFSET	00.0 dB
ON	OFF (out)
dBm/dB	dBm
dB/DIV	10
SMOOTHING	OFF

B. Advance INTENSITY control until a trace appears. Use DISPLAY POSITION control to center trace vertically. Then turn INTENSITY control fully counter-clockwise.

C. Turn R245, INTENSITY RANGE, fully CCW (see Figure 4-1 for location). Press the BEAM FINDER button and slowly adjust R245 until the trace just appears. Release BEAM FINDER and adjust INTENSITY control for normal trace.

D. Use DISPLAY POSITION control to move trace 3 major divisions up, and then down. Adjust both R286, ASTIG, and the FOCUS control for best definition of trace.

E. Position horizontal trace over the center horizontal graticule line. Check that the trace is parallel to the line. Adjust the rear panel TRACE ROTATION control to align trace horizontally.

F. If system has two log. amplifier plug-ins, replace temporarily the center (second) plug-in. Make sure the ON switch is off (out).

NOTE

If system has only one

log. amplifier plug-in, do the Geometry check by moving trace first to top and then bottom, and check bowing. Delete steps G, H, M, N. They use two plug-ins to check curvature, and also check the chopper circuit in mainframe.

G. Check that two traces appear. Use DISPLAY POSITION controls to position one of the traces at the top of the graticule and the other trace to the bottom. This also checks the chopper circuit.

H. Check that the bowing of the traces does not exceed 0.1 division. Adjust R285, GEOM, for minimum curvature of the two traces.

I. Use the DISPLAY POSITION control on one log. amplifier plug-in to move the trace off screen. Use same control on other plug-in to center trace vertically.

J. Set SWEEP RATE to MANUAL, and use vernier to position dot to right edge of center graticule.

CAUTION

Turn down INTENSITY to avoid burning screen.

K. Use DISPLAY POSITION control to move dot first to top graticule, and then to bottom. Bowing should not exceed 0.1 division. Re-adjust R285 if necessary.

L. Return SWEEP RATE control to FAST. Set one DISPLAY POSITION control full CW and the other full CCW.

M. Press BEAM FINDER button. Two bright traces should appear on screen.

N. Remove second (center) log. amplifier plug-in unit. Re-center the remaining trace.

O. (optional) Check External Intensity Input

1. Turn INTENSITY control until trace cannot be seen, but not fully counter-clockwise.

2. Connect a +5 Volt DC input to rear panel EXT INTENSITY INPUT BNC. Trace of normal brightness should be seen.

3. Disconnect +5 Volt DC input. Turn INTENSITY control until a trace of normal brightness is obtained.

4. Connect a -5 Volt DC input to EXT INTENSITY INPUT. The trace should not be visible.

5. Disconnect external voltage.

4. Check and Adjust Vertical Deflection Gain

A. With no RF input to log. amplifier plug-in, use DVM to measure DC output voltage at LEFT VERTICAL OUT (rear panel BNC). It should measure 0 ± 0.005 V.

B. Set SWEEP RATE to MANUAL and use vernier to center dot horizontally; use DISPLAY POSITION to center dot vertically. Turn on log. amplifier plug-in.

NOTE

Turn down INTENSITY to avoid burning spot in screen.

C. On Model 640E, connect RF detector in series between RF OUT of sweeper and RF INPUT of Model 640E. With other models, connect

a short cable from RF OUT of sweeper to RF INPUT of log. amplifier plug-in. Monitor DC output voltage from LEFT VERTICAL OUT with DVM while adjusting the RF OUT vernier. Adjust vernier until output is 0 V ± 0.002 V DC.

D. Continue to monitor output DC voltage while increasing OFFSET to obtain exactly 4.00 V DC (this will be obtained with an offset of approximately -40.0 dB.)

E. Change OFFSET ± to + and check that output DC voltage is -4.00 V DC ± 0.005 V. Return OFFSET ± to -. (Not applicable for Model 640R.)

F. Adjust R116 on mainframe (VERT GAIN) so dot is exactly aligned with top graticule line. Change OFFSET ± to + and check that dot is now on bottom graticule line.

G. Return OFFSET to 00.0, and turn off log. amplifier plug-in (ON button in out position).

5. Horizontal Deflection Gain and Centering Adjustment

NOTE

Steps A and B check the ramp voltage and the horizontal gain and centering. If the system passes both checks, no adjustment of the mainframe is required and steps C through G should be skipped.

A. Set SWEEP RATE to FAST. Connect HORIZONTAL OUTPUT signal (rear panel BNC) to vertical input of test scope. Check that the 0 to 10 V ramp is within the following limits:

0 ± 0.1 V
10 ± 0.2 V

B. Check that the trace on the CRT screen extends one trace width beyond graticule on both left and right hand sides.

NOTE

If either the HORIZ GAIN (R136) or HORIZ CENT (R657) require adjustment, the gain and centering of the log. amplifier plug-in will also require adjustment.

C. Remove the sweeper plug-in from the mainframe. Remove both side panels from sweeper. Reconnect sweeper to mainframe through extender cable.

D. Set SWEEP RATE to MANUAL, and connect DVM between pins 13A (+) and 13B (-).

NOTE

The DVM must have a floating input.

E. Adjust the sweep rate vernier until DVM reads 0 V ± 1 mV. Now adjust R657, HORIZ CENT, on mainframe (see Figure 4-2) to exactly center the dot horizontally on CRT screen.

F. Adjust the sweep rate vernier until DVM reads +250 mV ± 1 mV. Check that the dot is now on inside of righthand graticule (five divisions from center). If necessary, adjust R136, HORIZ GAIN, on mainframe to position dot exactly inside the righthand graticule.

G. Disconnect DVM from sweeper. Set SWEEP RATE to FAST.

H. This completes the CRT and Mainframe checks.

4-2.2 Model 640G Sweeper Plug-In, Checks and Adjustments

CAUTION

DO NOT MAKE ANY ADJUSTMENTS IN THIS PROCEDURE UNLESS THE TEST RESULTS ARE DEFINITELY OUT OF TOLERANCE AND YOU ARE CERTAIN THAT THE CHECKS WERE PERFORMED PROPERLY.

NOTE

Step 6 checks whether or not the gain and centering of the ramp voltage, or the linearity of the swept frequency need adjustment. If the system passed steps 5A and B, and now passes 6A through D, then no adjustment is required. In that event, proceed to step 12.

THE LINEARITY ADJUSTMENTS ARE ALL CRITICAL AND SHOULD NOT BE TOUCHED EXCEPT BY A QUALIFIED TECHNICIAN.

6. Gain, Centering and Linearity Checks

A. Set MARKER SPACING to 100 MHz and check that there are 15 of the 100 MHz markers.

B. Check that CENTER FREQUENCY is still on 500 MHz. Set the SWEEP WIDTH to 100 MHz/DIV. Adjust center frequency vernier so first marker on the far left just disappears off the end of the trace. Check that the remaining markers are within one small division of the major divisions.

C. Set CENTER FREQUENCY dial to 1000 MHz. Adjust the center frequency vernier so 1000 MHz is exactly on the center line of graticule. Check that all markers are within one small division of major division lines.

D. Set MARKER SPACING to 25 MHz and SWEEP WIDTH to 25 MHz/DIV. Vary CENTER FREQUENCY dial from 1500 MHz to 0 MHz, to check dial tracking in 100 MHz steps. On each setting, the 100 MHz marker should be within 35 MHz of center line.

NOTE

If unit passed steps 6A through 6D, then skip steps 7 through 11.

7. Adjusting Power Supply and Ramp Voltage

NOTE

Sweeper plug-in should be removed from mainframe, and with sides off. Use extender cable 640-ML-5282 to connect to mainframe. When measuring voltages, always use TP2 as the ground reference (see Figure 4-3).

A. Set SWEEP RATE to MANUAL (if sweep rate is not on manual setting, the test voltages below will read incorrectly).

B. Check the voltage at TP3. Adjust R6 for -15 V DC, ± 0.001 V. Check that voltage at TP1 is +15 V DC ± 0.3 V. Check TP5 is 14.8 ± 0.2 V, and TP4 is 24 ± 1.2 V DC.

C. Set front panel sweeper controls as

follows:

TRIGGER	AUTO
SWEEP WIDTH	FULL
SWEEP RATE	FAST
Vernier	Clockwise

D. Connect scope to TP9 and check that ramp is from -1.4 ± 0.2 V to + 10 ± 0.2 V.

E. Check that risetime is 22 ms ± 4 ms. Falltime should be 8 ms ± 2 ms.

F. Turn SWEEP RATE vernier to full CCW. Check that risetime is now 2 seconds, ± 0.5 seconds.

G. Set the SWEEP RATE to SLOW. As the vernier is turned from CCW to CW, the sweep speed should vary from 2 to 100 seconds (± 20%).

H. Change TRIGGER to EXT position. Pushing the SINGLE SWEEP button should activate a single sweep.

I. Short the center pin of the EXT TRIGGER (BNC on rear panel of mainframe) to ground. Check that the sweep is activated each time pin is shorted.

J. Change TRIGGER control to LINE, and SWEEP RATE to FAST. Monitor ramp at TP9 and check that the dwell time at beginning of sweep varies as the SWEEP RATE vernier is rotated.

K. Set TRIGGER to AUTO and SWEEP RATE vernier to full CW. Turn horizontal gain control, R89, (see Figure 4-3) to full CCW.

L. Adjust horizontal centering control, R92, so that dot on left hand end of trace is one trace width beyond first graticule line.

M. Adjust horizontal gain control, R89, until the trace is approximately one trace thickness past right edge of graticule.

N. Repeat steps M and N if necessary.

8. Adjusting Frequency Instruction

A. Set SWEEP RATE to MANUAL, and turn vernier full CW.

B. Connect a DVM between U14, pin 4 and U16, pin 13. Adjust R59 on sweeper for 0 ± 0.005 Volts. This calibrates the manual sweep ramp.

C. Set SWEEP WIDTH control to 100 MHz/DIV and turn the MANUAL vernier control to center dot on CRT.

D. Connect DVM to TP14 and adjust R96 (ΔF offset) for 0 ± 0.001 Volts. This calibrates center of the ΔF sweep ramp.

E. Move the SWEEP WIDTH control to the FULL position and connect DVM to TP15.

F. Turn the MANUAL vernier first CCW and then full CW, and record the voltage (below) at TP15 for each setting.

CCW _____ V

CW _____ V

G. Leave DVM on TP15. Set SWEEP WIDTH control to the CW position and CENTER FREQUENCY to 0 MHz.

H. Adjust CENTER FREQUENCY vernier so that cursor is straight up. Now adjust R110 (FREQ INSTR ZERO) to obtain same voltage as with MANUAL vernier in full CCW position.

I. Set CENTER FREQUENCY to 1500 MHz, being careful that vernier

cursor remains pointing straight up. Now adjust R111 (CENTER FREQ CAL) to obtain same voltage at TP15 as with MANUAL vernier in full CW position.

J. Set CENTER FREQUENCY to zero (0) MHz.

K. Leave DVM at TP15. Set SWEEP WIDTH to 100 MHz position and MANUAL vernier full CW. Adjust R99 (ΔF gain) for 1/3 of voltage obtained in step F, with MANUAL vernier full CW.

9. Oscillator Voltage Adjustment

A. Set the SWEEP WIDTH to FULL, and the SWEEP RATE control to MANUAL.

B. Turn the MANUAL vernier fully CW and turn R135, R140, R146, and R152 fully CCW (these latter are the SHAPER ADJ 1 through 4).

C. Monitor voltage at TP17 with DVM and adjust R130, GAIN ADJ, for 10 ± 0.005 Volts.

D. Locate the label on the RF Section showing the High VTO tuning voltage and Low VTO tuning voltage (see Figure 4-4).

E. Note and record the 4 voltages listed on the RF Section module:

HI VTO	LO VTO	
_____	_____	1 MHz
_____	_____	1500 MHz

F. Turn the MANUAL sweep rate vernier fully CCW and connect a DVM to TP19. Adjust R172 for the LO VTO 1 MHz voltage.

G. Leave DVM connected to TP19. Rotate MANUAL vernier fully CW and adjust R167 for the LO VTO 1500 MHz voltage.

H. Connect DVM to TP18. Turn MANUAL sweep rate vernier fully CCW and adjust R162 for HI VTO 1 MHz voltage.

I. Turn the MANUAL vernier fully clockwise and adjust R157 for the HI VTO 1500 MHz voltage as measured at TP18.

10. Linearization, Final Adjustments

NOTE

The RF POWER LEVELING ADJUSTMENT (step 12) must be done on all sweeper plug-ins. It has therefore, been made the last step. However, on those units requiring LINEARIZATION adjustments, the power leveling should be done first. This insures that incorrect levels or oscillations will not cause marker beats.

A. Do the power level adjustments listed under step 12.

B. Set CENTER FREQUENCY to 500 MHz, and MARKER SPACING and SWEEP WIDTH both to 100 MHz.

C. Adjust CENTER FREQUENCY vernier so zero (0) 100 MHz marker just moves off beginning of trace.

D. Adjust R130 (GAIN ADJ) on sweeper so that first 3 of remaining markers fall on major division lines on CRT screen.

E. Adjust R135 (first breakpoint) to pull 300 MHz to 700 MHz markers onto the major division lines. Ad-

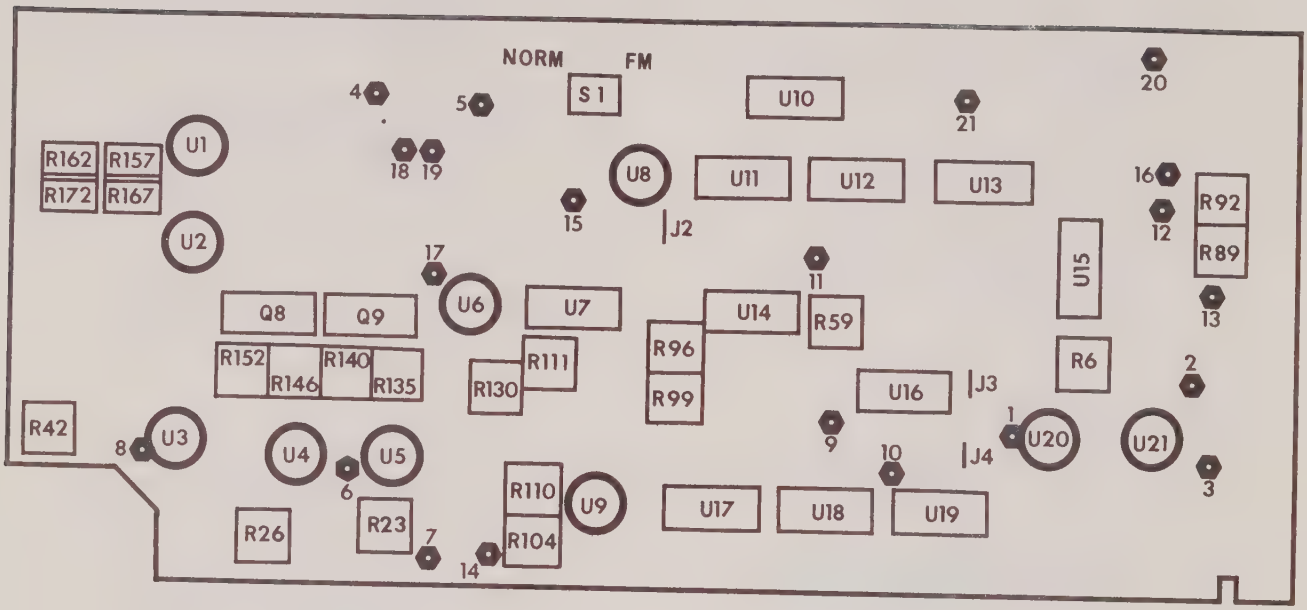


Figure 4-3. Sweeper, PC Board Assembly

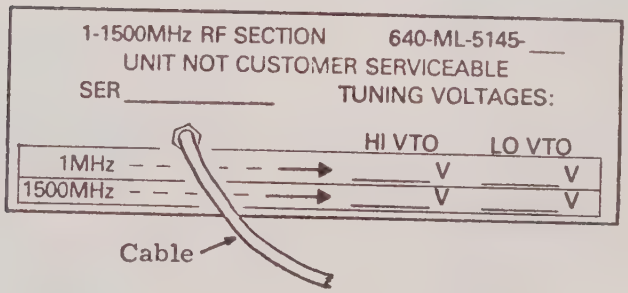


Figure 4-4. Location of RF Section Tuning Voltages

just R140 (second breakpoint) to get 700 to 1000 MHz markers onto the major division lines.

F. Re-adjust R135 and R140 if necessary.

G. Set CENTER FREQUENCY to 1000 MHz.

H. Adjust R146 (3rd breakpoint) to pull 1000 to 1200 MHz markers onto the major division lines. Adjust R152 (4th breakpoint) to pull 1300 to 1500 MHz markers onto major division lines.

I. Re-adjust R146 and R152 if necessary.

J. Set SWEEP WIDTH to FULL. Check that the zero (0) and 15th markers are within one small division of the left hand edge and right hand edge of the CRT graticule respectively.

NOTE

These are the final fine adjustments for linearization. If there appears to be a considerable error in linearity, do NOT "touch up" the oscillator voltages (steps K and L below). Instead, go back and repeat steps 8 and 9, and then begin over with step 10.

K. Adjust R157 (HI VTO 1500 MHz ADJ) to place 15th marker on right hand edge of graticule.

L. If necessary, adjust R162 (HI VTO 1 MHz ADJ) to move the zero (0) marker off left hand edge of trace.

M. Go back and re-check steps B through J.

11. Dial Calibration and SWEEP WIDTH Range Adjustments

A. Set MARKER SPACING on 25 MHz, SWEEP WIDTH on 5 MHz per division, and CENTER FREQUENCY dial on 0 MHz. Make sure center frequency is set so cursor points straight up.

B. Adjust R110 (FREQ INSTR ZERO) so 100 MHz marker is exactly on center graticule line.

C. Set CENTER FREQUENCY dial to 1500 MHz. Be careful not to move CENTER FREQUENCY vernier.

D. Adjust R111 (CENTER FREQUENCY CAL) so that the 100 MHz marker is exactly on the center line.

E. Set CENTER FREQUENCY dial on each 100 MHz step in turn, checking that 100 MHz marker remains within ± 35 MHz of center line of graticule.

NOTE

Although specification is ± 35 MHz, calibration is typically within 15 MHz. It is, therefore, recommended that the SWEEP WIDTH be left on 5 MHz/DIV (± 25 MHz overall) during the above check.

F. Set SWEEP WIDTH to FULL and MARKER SPACING to 100 MHz. Select a 100 MHz marker which is closest to (or exactly on) a 300 MHz, 600 MHz, 900 MHz or 1200 MHz division, and adjust the CENTER FREQUENCY dial so that the variable marker is exactly on top of that marker.

G. Set SWEEP WIDTH to 100 MHz, and use CENTER FREQUENCY vernier to exactly center the 100 MHz marker on CRT graticule.

H. Set SWEEP WIDTH to 1 MHz/DIV and MARKER SPACING to 1 MHz. Use CENTER FREQUENCY vernier (if necessary) to re-center 100 MHz marker.

I. Adjust R104 (ATTEN CAL) to get 1 MHz markers on right hand side exactly on major division lines.

J. Select another center frequency below 500 MHz and use center frequency vernier to center 100 MHz marker. Check that 1 MHz markers are within one major division (± 1 MHz) of correct position.

K. Select another center frequency nearer to 1500 MHz and repeat step J.

12. RF Power Leveling Adjustment

A. Set sweeper plug-in controls as follows:

MARKER SPACING	OFF
SWEEP WIDTH	FULL
SWEEP RATE	MANUAL
Vernier	Full counter-clockwise
TRIGGER	AUTO
WIDTH VERNIER	CAL
RF OUT	+10 dBm
Vernier	At 3 o'clock

B. Set log. amplifier plug-in controls as follows:

OFFSET ±	+
OFFSET dB	10.0 dB
ON	OFF (out)
dBm/dB	dBm
dB/DIV	0.2 dB
SMOOTHING	OFF

C. Use an accurate power meter for Steps D, E, F and G.

NOTE

The Model 640E or 640T log. amplifier plug-in can be used as the power meter, if known to be in calibration, to verify the power calibration of the sweeper plug-in. But if the entire system is to be verified, then another power meter must be used.

D. Connect RF OUT of sweeper plug-in to power meter input (use a detector in series, if Model 640E is used for power meter).

E. Set MANUAL sweep control at 0 MHz (SWEEP RATE VERNIER fully CCW). Read power out on meter.

F. Set MANUAL sweep control at 1500 MHz (SWEEP RATE VERNIER fully CW). Read power out on meter.

G. Adjust SLOPE control on sweeper plug-in until readings are the same in steps E and F.

H. Set SWEEP WIDTH to FULL. If separate power meter was used, disconnect power meter.

I. Remove log. amplifier plug-in from mainframe, and remove right side of plug-in unit.

J. Identify location of R31, DET SLOPE (see also Figure 4-5) and reinsert log. amplifier into mainframe.

K. Adjust INTENSITY as desired for viewing trace, and use DISPLAY POSITION control to center trace vertically.

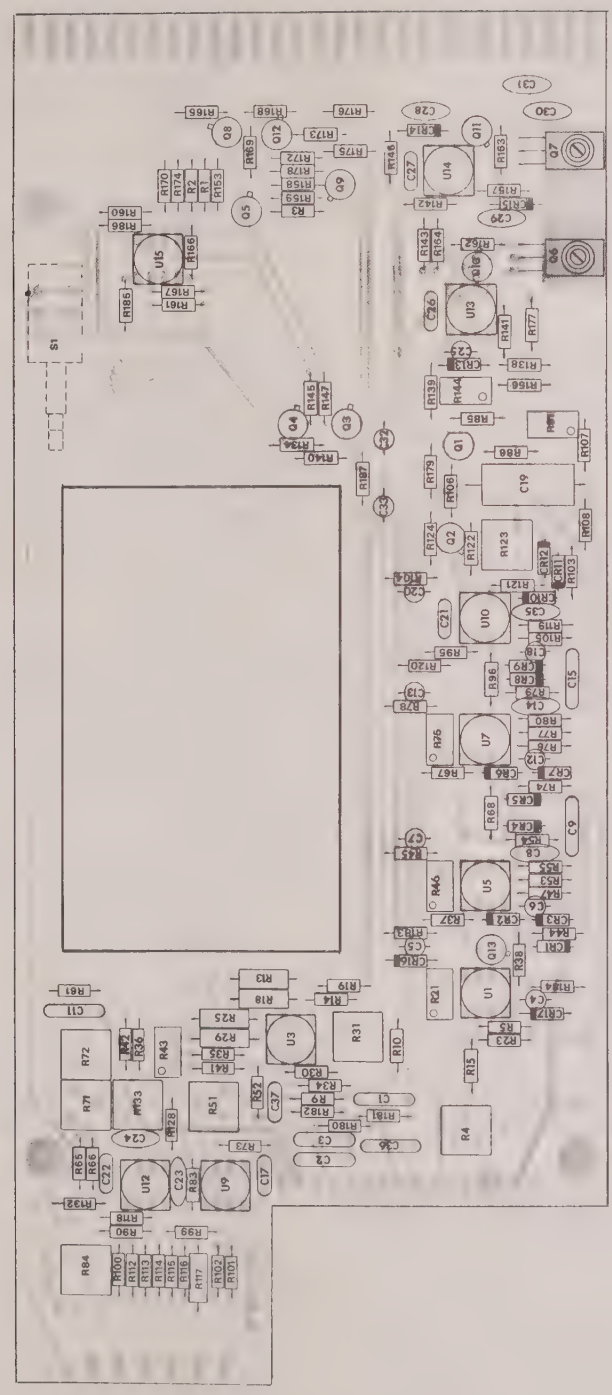


Figure 4-5. Log. Amplifier Plug-In PC Board Assembly

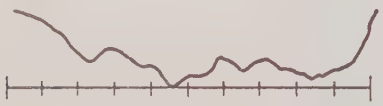
L. Connect a short cable from RF OUT dBm on sweeper plug-in to RF INPUT of log. amplifier plug-in. (If Model 640E is used, connect RF Detector in series between sweeper and amplifier).

M. Turn log. amplifier plug-in on (press in the ON switch).

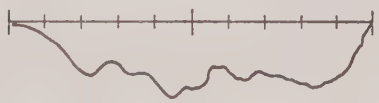
N. Adjust R31, DET SLOPE control on log. amplifier plug-in so both ends of trace are at same height.

O. Check that the RF leveling low and high points on the trace are not separated by more than 0.6 dB over the full frequency range.

P. Check that RF OUT dBm of sweeper plug-in is + 10 dBm, and that an OFFSET of + 10.0 dB is set into log. amplifier. Now adjust R23, MAX POWER ADJ in sweeper, to lay lowest point of trace on zero reference line. (This ensures that minimum power out is at least + 10 dBm.)



Q. Set OFFSET on log. amplifier plug-in to 00.0 dB. Leave RF OUT on sweeper at +10 dBm but turn vernier fully CCW. Adjust R42, MIN POWER ADJ, on sweeper plug-in to lay highest point of trace on reference line. (This ensures that vernier has a range of at least 10 dB).



R. Repeat steps P and Q if necessary.

S. Check the trace carefully for presence of any oscillations. If necessary, adjust R26 in the sweeper plug-in.

T. Re-set vernier to 3 o'clock position.

U. Remove extender cable, and replace sides on sweeper plug-in. Re-insert sweeper plug-in into mainframe. Remove log. amplifier plug-in, replace side, and re-insert into mainframe.

4-2.3 Model 640E, 640R, and 640T Log. Plug-Ins, Checks and Adjustments

CAUTION

DO NOT MAKE ANY ADJUSTMENTS IN THIS PROCEDURE UNLESS THE TEST RESULTS ARE DEFINITELY OUT OF TOLERANCE AND YOU ARE CERTAIN THAT THE CHECKS WERE PERFORMED PROPERLY.

NOTE

Remove the log. amplifier plug-in from the mainframe and take off both sides. Reconnect log. amplifier to mainframe through extender cable.

Warm up system for at least 1/2 hour before beginning tests.

13. Initial Setup

A. Set front panel controls on sweeper plug-in as follows:

CENTER FREQUENCY	100 MHz
Vernier	Cursor straight up
MARKER SPACING	OFF
SWEEP WIDTH	1 MHz
SWEEP RATE	FAST
Vernier	Clockwise
TRIGGER	AUTO
WIDTH VERNIER	CAL
RF OUT dBm	0 dBm
Vernier	Cursor at 3 o'clock

B. Set front panel controls on log. amplifier plug-in as follows:

dB/DIV	10 dB
OFFSET ±	+ (Model 640E, 640T only)
OFFSET dB	00.0
SMOOTHING	OFF
DISPLAY POSITION	Center trace vertically
ON	OFF (out)

NOTE

ON MODEL 640E PLUG-IN, THE EXTERNAL RF DETECTOR MUST BE CONNECTED TO THE INPUT OF LOG. AMPLIFIER. DO NOT CONNECT RF OUTPUT OF SWEEPER PLUG-IN TO INPUT OF MODEL 640E.

C. Set the SWEEP RATE to SLOW and adjust sweep rate vernier for an approximate 20 second sweep.

14. Power Supply, Checks and Adjustments

A. Use TP8 for ground return in following checks.

B. Connect DVM to TP6 and adjust R144 for -15 V ± 0.001 V.

C. Connect DVM to TP7 and check voltage is +15 V ± 0.3 V.

15. Preamplifier Balance, Checks and Adjustments

NOTE

The following adjustments should only be necessary following the replacement of amp U1, U5, U7, or U10. Those marked with an asterisk (*) are most critical.

A. Solder a jumper from TP12 to TP13.

B. Use TP8 for ground return in all checks in table at bottom.

not in later model

C. Monitor TP5 to TP15 differentially and adjust R91 for 0 V ± 30 microvolts (get as close to zero as possible).

D. Remove jumper from TP12 and TP13.

16. Thermistor Checks

A. Monitor TP14 to ground (TP8) and record voltage below:

_____ V DC

B. On Model 640R, T plug-ins, unsolder green wire from wirepoint 7. On Model 640E, disconnect standard RF detector from front panel.

C. Note and record the new reading at TP14:

OP AMP	MONITOR TP	ADJUST	TOLERANCE
U7	TP2	R75	0 V ± 10 microvolts
U5	TP1	R46	0 V ± 10 microvolts
U10	TP3	R123	0 V ± 80 microvolts *
U1	TP4	R21	0 V ± 2 millivolts *

_____ V DC

D. Subtract readings and verify that the difference is within the following tolerances:

Model 640R, T: 43 mV ± 5 mV
Model 640E : 43 mV ± 10 mV.

E. On Models 640 R, T plug-ins, resolder green wire to wirepoint 7. On Model 640E, reconnect detector to front panel.

17. Output Amplifier, Gain and Offset Adjustment

A. Place a temporary jumper from TP18 to ground.

Junction of 200K 5% resistor and 100K 1% on later model.

B. Turn on amplifier (push ON button in).

NOTE

Do not take readings or make adjustments during retrace, but only during trace.

C. Check that the dB/dBm switch is in the dBm position. (On the Model 640R plug-in, temporarily ground wiper of R94, the ZERO dB SET pot.)

D. Connect RF OUT from sweeper plug-in to RF INPUT of Models 640R, T plug-ins (with Model 640E, connect RF output to the RF detector). Set sweeper gen to very slow speed

E. Monitor voltage from Jumper F, G to ground (TP8). Adjust RF OUT vernier on sweeper plug-in for 0 V ± 1 mV.

F. Monitor voltage differentially from F, G to TP9.

NOTE

R133 and R84 interact considerably, so do not try to get zero on first attempt. Bring each control in gradually.

G. With 0 dBm setting of RF OUT on sweeper plug-in, adjust R133 ZERO for reading of 0 V ± 100 microvolts.

not on some later model

H. With + 10 dBm setting of RF OUT on sweeper plug-in, adjust R84 OUTPUT GAIN for 0 V ± 200 microvolts.

but should be to 0V ± 1mV

I. Repeat steps G and H. Get as close to zero as possible. (Be careful not to change RF OUT vernier when switching from 0 dBm to + 10 dBm output.)

Remove jumper from TP18 to Gnd

18. Offset Attenuator Dial Tracking Adjustment

A. Leave input at + 10 dBm. Differential reading from Jumper F, G to TP9 should stay 0 V ± 1 mV.

B. On Models 640E, T, increase OFFSET to exactly + 10.0 dB, and adjust R71 for differential reading of + 1 V ± 1 mV.

C. On Models 640E, R, and T plug-ins, increase OFFSET to -25.0 dB, and adjust R72 for -2.5 V ± 1 mV.

19. 100mV/dBm and 0 dBm Offset Adjustment

A. Set OFFSET to -00.0 dB. Set RF OUT dBm of sweeper plug-in to 0 dBm.

B. Monitor voltage at TP16 to ground (TP8), and adjust R43, 0 dBm OFFSET, for 0 V ± 3 mV.

C. Change RF input to -10 dBm. Adjust R51 for -1 V ± 3 mV.

D. Repeat steps A through C until no further change in settings is noted.

E. Remove temporary ground from wiper of R94 (Model 640R plug-in only).

20. dB/DIV Accuracy Check

NOTE

The following checks are provided to ensure the divider network has not shifted in value.

A. Connect DVM to TP9 (TP8 is ground return).

B. Set controls on log. plug-in as follows:

OFFSET	00.0 dB
dB/DIV	2 dB
dB/dBm	dB (Models 640E, T only)

C. Set ZERO dB SET on front panel to read + 1 V ± 1 mV on DVM.

D. Change the dB/DIV setting as follows, and verify voltage readings shown:

10 dB/DIV	+0.2V ±50 mV
5	+0.4V ±10 mV
2 (reference)	+1.0V ±1 mV
1	+2.0V ±25 mV
.5	+4.0V ±80 mV
.2 (Models 640E, T only)	+10.0V ±200 mV

4-2.4 Model 640L Linear Amplifier, Checks and Adjustments

CAUTION

DO NOT MAKE ANY ADJUSTMENTS IN THIS PROCEDURE UNLESS THE TEST RESULTS ARE DEFINITELY OUT OF TOLERANCE AND YOU ARE CERTAIN THAT THE CHECKS WERE PERFORMED PROPERLY.

21. Initial Setup

NOTE

The linear amplifier should be removed from the mainframe, both side panels removed, and the unit then reconnected through an extender cable.

The amplifier, sweeper and mainframe should be on for at least 1/2 hour before beginning the verification checks.

A. Set the front panel controls on the sweeper plug-in as follows:

CENTER FREQUENCY	100 MHz
Vernier	Cursor straight up
MARKER SPACING	OFF
SWEEP WIDTH	1 MHz
SWEEP RATE	FAST
Vernier	Clockwise
TRIGGER	AUTO
WIDTH VERNIER	CAL
RF OUT dBm	-20 dBm
Vernier	Cursor at 3 o'clock

B. Set the front panel controls on the linear amplifier as follows:

mV/DIV	1000
INPUT	GND
OFFSET mV	00.0
DISPLAY POSITION	Center trace vertically
ON	OFF (push in)
GAIN VERNIER	CAL

C. Set the SWEEP RATE to SLOW and adjust sweep rate vernier to obtain an approximate 20 second sweep.

22. Power Supply Checks and Adjustments

A. Use TP8 for ground return in following checks.

B. Connect DVM to TP6 and adjust R144 for -15 V ± 0.001 V.

C. Connect DVM to TP7 and check voltage is + 15 V ± 0.3 V.

23. Preamplifier Balance Checks and Adjustments

NOTE

The following adjustments should only be necessary following replacement of OP amp U1, U5, U7 or U10.

A. Solder a jumper from TP12 to TP13.

B. Use TP8 for ground return in all checks in table below:

C. Monitor TP5 to TP15 differentially, and adjust R91 for 0 V ± 30 microvolts (get as close to zero as possible).

24. Output Amplifier Adjustments

A. Monitor TP9 to ground (TP8). Adjust R133 for 0 V ± 100 microvolts.

B. Remove jumper from TP12 and TP13.

C. Connect Reference Supply (see Test Fixture, Table 4-1) to BNC INPUT connector. Set INPUT switch to +. Check that mV/DIV switch is set to 1000.

D. Use DVM to set input to + 1 V ± 10 microvolts.

E. Monitor TP9 and adjust R84 for + 1 V ± 100 microvolts.

NOTE

Make adjustments or measurement only during forward sweep time.

25. Offset Dial Tracking Adjustments

A. Set the OFFSET dial to 999 mV.

B. Set voltage at BNC INPUT to + 1 V ± 10 microvolts.

C. Monitor voltage at TP9, and adjust R72 to read + 1 mV ± 100 microvolts.

26. mV/DIV Accuracy Check

A. Leave OFFSET dial at 999 mV.

B. Check that voltage at BNC INPUT is + 1 V ± 10 microvolts.

OP AMP	MONITOR AT TP	ADJUST	TOLERANCE
U7	TP2	R75	0 V ± 10 microvolts
U5	TP1	R46	0 V ± 10 microvolts
U10	TP3	R123 *	0 V ± 80 microvolts
U1	TP4	R21 *	0 V ± 10 millivolts

* These adjustments are the most critical.

C. Monitor voltage at TP9, and verify following readings for each listed setting of the mV/DIV switch:

1000 mV/DIV	+1 mV ±100 microvolts
250	+400 mV ±150 microvolts
100	+10 mV ±200 microvolts
25	+40 mV ±500 microvolts
5	+200mV ±2 microvolts
1	+1 V ±10 microvolts

4-3 TROUBLESHOOTING, QUICK CHECKS

Tables 4-2 through 4-7 give procedures for checking the operation of the system and isolating any faults. They are relatively simple, and designed to isolate the trouble to one plug-in unit, or a specific PC board; the technician must then go to the schematics (in Section VI) to further identify the problem.

If a trouble occurs during a specific step, the chart refers the technician to other checks, to an adjustment (in the Performance Verification checks), or to a schematic. Be careful not to omit any steps. The recommendations are always based upon the assumption that the system has passed all previous steps.

If a reference is made to an adjustment under Performance Verification, it can either be made without effecting the calibration of other boards, or the impact is clearly identified.

4-4 MAINTENANCE NOTES

4-4.1 Diode Replacement, RF Components

The Model 6 Series SWR Autotesters and Model 7 Series RF Detectors contain a diode that can be replaced by the user if it becomes faulty. Following are procedures for replacing the diode. WILTRON Part No. 10-8 is the diode used in the 640T and Series 7 Detectors. Diode Part No. 10-9 is used for the 640R and Series 6 SWR Autotesters.

NOTE

If the diode is being replaced in a Model 7 series RF Detector, a Power Meter (including Thermistor Mount) is required for re-calibration.

DIODE REPLACEMENT IN MODEL 6 SERIES SWR AUTOTESTERS

1. Remove the 2 screws from the SWR Autotester and detach the cover.

2. Unplug the diode from the SWR Autotester and carefully install the new diode with the cathode positioned as shown below.

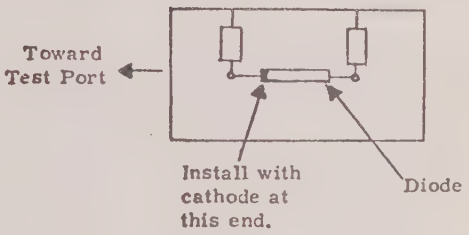


Figure 4.6 Location of Diode

3. Attach the cover to the SWR Autotester and secure it with the 2 screws.

4. Re-calibration is not required for the new diode.

DIODE REPLACEMENT IN MODEL 7 SERIES RF DETECTORS

1. Remove the 2 screws from the RF Detector to detach the cover.

2. Unplug the diode from the unit and carefully install the new diode with the cathode positioned as shown below.

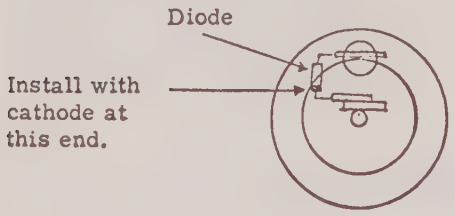


Figure 4-7. Location of Diode

3. Connect the RF Detector to the Model 640E Log. Plug-In. Install the Log. Plug-In in the Model 640 mainframe.

4. Connect from the RF OUT connector on the Sweep Generator Plug-In to the input of the thermistor mount. Connect the output of the thermistor mount to the power meter.

5. Turn the system power ON. Set the Sweep Generator controls as follows:

   SWEEP RATE: MANUAL
   SWEEP WIDTH: CW
   CENTER FREQUENCY: 750 MHz
   RF OUT: +10 dBm

6. Adjust the center knob of the RF OUT control for a power meter reading of exactly +10 dBm.

7. Set the Model 640E Log. Plug-In controls as follows:

   ON: "On" position
   dB/DIV: .2
   DISPLAY POSITION: To desired reference line
   dBm/dB: dBm
   ZERO dB SET: Set coincident to reference line

8. Set the OFFSET control on the Model 640 E Log. Plug-In to +10.0 dB.

9. Disconnect the thermistor mount from the RF OUT connector, and using a short cable, connect from the RF OUT connector to the INPUT connector on the Model 640E Log. Plug-In.

10. Check that the trace is coincident with the reference line. If not, adjust the trimmer potentiometer in the RF Detector.

11. Turn the system power OFF. Disconnect the test equipment.

12. Attach the cover to the RF Detector and secure it with the 2 screws.

4-4.2 RF Section Replacement

NOTE

RF Sections having serial numbers with middle digits of 00, 01, 02, or 03 use a modulator that requires approximately -6 V for minimum attenuation, and 0 V for maximum attenuation. RF Sections with serial numbers with middle digits of 04 and higher use a PIN diode modulator, as shown in the schematic diagram Figure 4-8 the following page. For these units, increasing attenuation requires increasing the positive current into the diode. To supply this amount of current, diode CR5 must be removed from the Sweep Generator PC Assembly Board. This will be necessary if the newer type RF Section with the PIN modulator is replacing an older type RF Section.

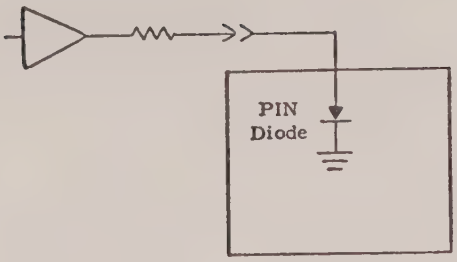


Figure 4-8. Equivalent Circuit of PIN Modulator

1. Turn off the system power.

2. Remove the Sweep Generator Plug-In from the mainframe.

3. Pull the side covers off the plug-in.

4. Remove four screws from the Model 640G top extrusion. Also remove four screws from the bottom extrusion. Disconnect the RF output cable from the attenuator.

5. Gently pull the RF and Marker Sections straight up and out from the chassis.

6. To separate the RF and Marker Sections, remove the four screws from the overlapping plate. Then unplug the RF Section from the Marker Section.

CAUTION

Do not attempt repair of the RF Section. Return the RF Section to the factory for modular exchange. Note that if the RF Section is opened, the Warranty is void.

7. Connect the extender cable to the Sweep Generator Plug-In.

8. Set the front panel controls as follows:

   SWEEP WIDTH: FULL
   SWEEP RATE: MANUAL

   Turn the system power ON.

9. With the SWEEP RATE VERNIER set fully CCW, measure at TP7 on the PC Assembly Board for 0 ± 50 mV. If voltage is not normal, check the circuits prior to TP7.

10. Turn the SWEEP RATE VERNIER control fully CW. Check that the voltage at TP17 is 10 V ± 10 mV. If not, adjust R130.

11. Turn the SWEEP RATE VERNIER fully CCW. While measuring at TP18, adjust R162 for the HIGH VTO voltage labeled on the RF Section for 1 MHz. This is the top voltage under HIGH VTO (see Figure 4-4).

12. Turn the SWEEP RATE VERNIER control fully CW and adjust R157 for the voltage labeled on the RF Section under HIGH VTO for 1500 MHz.

13. Turn the SWEEP RATE VERNIER fully CCW, and while measuring at TP19, adjust R172 for the LOW VTO voltage labeled on the RF Section for 1 MHz.

14. Turn the SWEEP RATE VERNIER control fully CW and adjust R167 for the LOW VTO voltage for 1500 MHz.

15. Turn the system power OFF, then connect the Marker Section and the new RF Section together and secure them using the four screws.

16. Plug both sections onto the Sweep Generator PC Assembly Board.

17. Connect the RF cable to the attenuator. Secure the Marker and RF Sections to the chassis extrusions using the screws removed in step 4.

18. Turn the system power ON and re-adjust the ALC top and bottom limits as follows; with the RF OUT attenuator set at + 10 dBm:

    a. Set the POWER LEVEL VERNIER fully CW and adjust R23 for a power level output of + 10.5 dBm.

    b. Set the POWER LEVEL VERNIER fully CCW and adjust R42 for an RF power output of -1 dBm.

19. On the RF Sweep Generator front panel, set the SWEEP WIDTH for 100 MHz/DIV, and the MARKER SPACING at 100 MHz. Adjust R130, R135, R140, R146, and R152 for best linearity. Adjust R130 for the low end marker spacing. R135 becomes effective at 200 MHz, R140 at 400 MHz, R146 at 1000 MHz, and R152 at 1300 MHz. The objective is to get the 100 MHz markers as evenly-spaced as possible.

20. Install the Sweep Generator Plug-In in the mainframe and check out the system in accordance with the operating instructions.

4-4.3 Marker Section Troubleshooting

1. With system power OFF, remove the RF Sweep Generator Plug-In from the mainframe and connect it to the mainframe using the extender cable. Pull the side covers off the plug-in.

2. With system power ON, check for the proper voltages at the pins of connector XA4 as shown in Table 4-12, following. These pin numbers are identified in Figure 4-9.

3. If any of the voltages are not normal, use the schematic diagrams to trace the portion of the circuits where the abnormal reading was obtained. If all readings at connector XA4 are normal, the trouble is in the Marker Section itself.

4-4.4 Marker Section Replacement

1. Turn off the system power.

2. Remove the Sweep Generator Plug-In from the mainframe.

3. Pull the side covers off the plug-in.

4. Remove four screws from the Model 640G top extrusion. Also remove four screws from the bottom extrusion. Disconnect the RF output cable from the attenuator.

5. Gently pull the RF and Marker Sections straight up and out from the chassis.

6. To separate the RF and Marker Sections, remove the four screws from the overlapping plate. Then unplug the RF Section from the Marker Section.

CAUTION

Do not attempt repair of the Marker Section. Return the Marker Section to the factory for modular exchange.

7. Connect the new Marker Section and the RF Section together and secure them using the four screws.

8. Plug both sections onto the Sweep Generator PC Assembly Board.

9. Connect the RF cable to the attenuator. Secure the Marker and RF Sections to the chassis extrusions using the screws removed in step 4.

Table 4-12. Voltages at Interface Connector XA4 on Sweep Generator Plug-In (640G) PC Assembly

MARKER SPACING SWITCH POSITION	CONNECTOR XA4 PIN NO.									
	1	2	3	4	5	6	7	8	9	10
100	-15V	-15V	+5V	(0)	(1-F) (0-R)	(0)	(0)	(0)	(0)	Note 4
25	-15V	-15V	+5V	(1-F) (0-R)	(1-F) (0-R)	(0)	(0)	(0)	(0)	Note 4
5	-15V	-15V	+5V	(1-F) (0-R)	(1-F) (0-R)	(1-F) (0-R)	(0)	(0)	(0)	Note 4
1	-15V	-15V	+5V	(1-F) (0-R)	(1-F) (0-R)	(1-F) (0-R)	(0)	(1-F) (0-R)	(0)	Note 4
EXT	-15V	0V	+5V	(0)	(1-F) (0-R)	(0)	(0)	(0)	(0)	Note 4
OFF	-15V	-15V	+5V	(0)	(0)	(0)	(0)	(0)	(0)	Note 4

Notes:

1. (0) = logic zero (approx. 0 VDC) for forward sweep and retrace.
2. (1-F) = logic one (2.5 to 5.5 VDC) for forward sweep.
3. (0-R) = logic zero (approx. 0 VDC) for retrace.
4. Signal is 0 VDC with negative-going markers, with amplitude dependent on MARKER SPACING switch position as follows:

   1: approx. -0.8V peak
   5: approx. -1.6V peak
   25: approx. -2.4V peak
   100: approx. -3.2V peak

   } with MARKER SPACING switch set to 1 MHz.

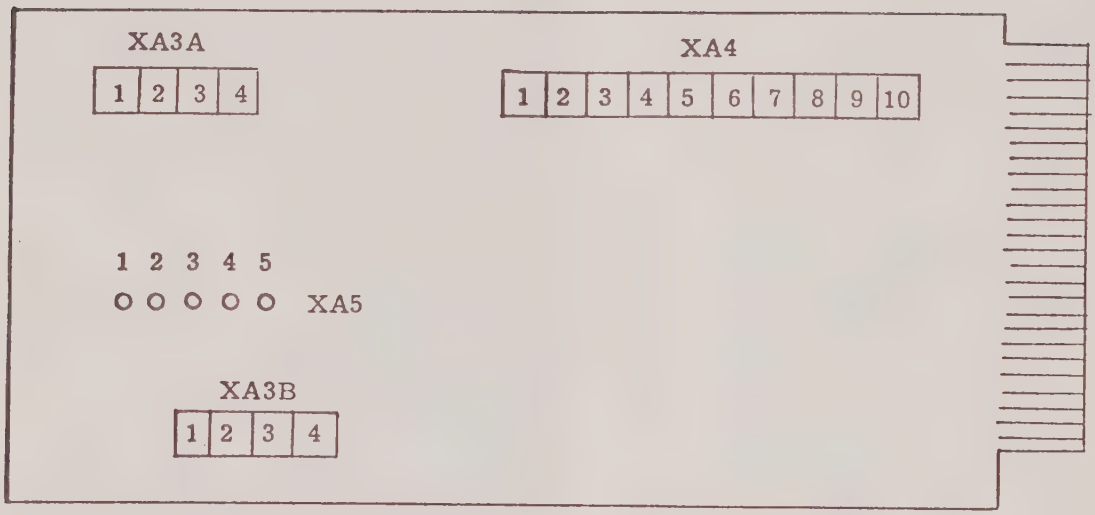


Figure 4-9. Sweep Generator (640G) PC Assembly Location and Pin Designations of Interface Connectors

HOW TO USE THE TROUBLESHOOTING CHART

1. First perform the initial setup control settings as shown in Table 4-2.

2. Start with Table 4-3, and perform each step in the sequence shown. Continue through each Table in turn until the trouble is found.

3. Perform the steps shown in the "Action" column and check that the indication is as stated in the "Result" column. If result is normal, proceed to next "Action" step. If not, refer to the "Comments on Trouble Indication" column for additional instructions.

4. To troubleshoot the circuit, refer to the schematic diagram listed in the "Schematic Reference" column.

5. In some steps, a reference is made to steps in the Performance Verification procedure. These steps must be completed before continuing the troubleshooting steps.

   Example 1: Table 4-3, Step 7

   Horizontal trace absent. Sawtooth waveform does not appear on test scope, therefore, sweeper plug-in is faulty. Use Figure 6-6 or 6-7 to locate trouble in horizontal circuits.

   Example 2: Table 4-3, Step 7

   Horizontal trace appears on Model 640 screen, but INTENSITY control does not turn off trace. Refer to step 3C of Performance Verification for adjustment procedure.

Table 4-2. Initial Setup

Unit and Control	Setting
Model 640G Sweeper Plug-In	
CENTER FREQUENCY, MHz	0 MHz
Vernier	(Centered)
MARKER SPACING	OFF
SWEEP WIDTH	FULL
SWEEP RATE	FAST
Vernier	(Full CW)
TRIGGER	AUTO
WIDTH VERNIER	CAL
RF OUT dBm	0 dBm
Vernier	(at 3 o'clock)
Log. Amplifier Plug-Ins (*not on Model 640R)	
OFFSET, ± *	+
OFFSET, dB	0.00 dB
ON	(out = off)
dBm/dB *	dBm
dB/DIV	10 dB
SMOOTHING	OFF
Linear Amplifier Plug-In (checked last)	
OFFSET, mV	00.0 mV
mV/DIV	100
INPUT	GND
GAIN VERNIER	CAL
ON	Off (out)
Mainframe	
MARKER AMPL	(Full CCW)
INTENSITY	(Full CCW)
NOTE: Remove sweeper plug-in, and one log. amplifier plug-in. If the system uses both the Model 640T and 640R, remove the Model 640R plug-in.	

Table 4-3. CRT Beam and Sweep Ramp Checks

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
1	Pull POWER switch out.	Light on front panel comes on.	If no light nor dot, check fuse in rear panel. If fuse is o.k., check all DC volts from LV power supply. If no DC volts, check thermal breaker.	LV power supply, Fig. 6-2	
2	Press BEAM FINDER button. NOTE: Allow a 30 minute warmup before proceeding.	Dot appears on screen.	If light on, but no dot, check BEAM FINDER circuit. Check HV power supply (3.4 kV) and CRT.	See Fig. 6-3 or Fig. 6-4	Step 3C, or 2D
3	Hold in BEAM FINDER and adjust the FOCUS control. NOTE: Be careful not to burn the screen with high intensity dot.	Focus to fine dot (and check the roundness throughout range of FOCUS control).	Astigmatism (ASTIG., R286) needs adjustment, if dot does not stay round.		3D
4	Hold in BEAM FINDER and run the DISPLAY POSITION to both ends.	Dot moves to top and to bottom, but stays on the screen.	If dot doesn't move, try other log. amplifier plug-in. If dot still doesn't move, fault in mainframe. If dot goes off screen, fault in BEAM FINDER circuit or in CRT deflection circuit.	See Fig. 6-1, 4 or Fig. 6-14 See Fig. 6-3 or Fig. 6-4	
5	Hold in BEAM FINDER and use the DISPLAY POSITION to center dot vertically.				
6	Plug in the 640G Sweeper Plug-In.				
7	Turn up INTENSITY control and check that it works.	Horizontal trace appears, and control can turn off the trace.	If no horizontal trace appears, connect cable from HORIZ OUTPUT (rear panel) to test scope. If no sawtooth waveform appears, trouble in sweeper plug-in. If sawtooth appears, trouble in mainframe. If INTENSITY control does not cut off beam, the BEAM FINDER circuit needs adjustment.	Sweepers: Fig. 6-6, 7 Mainframe: Fig. 6-1, 4	3C
8	Check that trace is horizontal.	Trace is parallel to graticule line.	If trace is tilted, adjust TRACE ROTATION (rear).		
9	Check width of trace.	Trace extends one trace thickness beyond graticule on left and right sides.	If trace not full width, make checks and adjustments given in Step 5 (Performance Verification). NOTE: If adjustments of step 5 are made, it will be necessary to check all steps under 6.		5 6
10	Set TRIGGER to LINE position.	Trace continues to appear.	If no sweep on LINE, fault is in sweeper plug-in.	Fig. 6-6	
11	Set TRIGGER to EXT. Press the SINGLE SWEEP button.	A single sweep occurs.	If no single sweep occurs, short center pin of EXT TRIGGER (BNC on rear panel). If sweep is activated, trouble is in switch; if sweep is not activated, trouble in circuit.	Fig. 6-7	

Table 4-3. CRT Beam and Sweeper Ramp Checks (con't)

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
12	Return TRIGGER to AUTO position.				
13	Set SWEEP RATE on FAST and vernier full counter-clockwise.	Sweep takes about 2 seconds (± 20%).	If sweep rate is off, fault is in sweeper plug-in.	Fig. 6-6	
14	Set SWEEP RATE on SLOW and vernier full clockwise.	Sweep takes about 2 seconds (± 20%).	If sweep rate is off, fault is in sweeper plug-in.		
15	Turn vernier counter-clockwise.	Sweep takes from 80 to 120 seconds.	If sweep rate is off, fault is in sweeper plug-in.		
16	Set SWEEP RATE to MANUAL, vary vernier from CW to full CCW.	Dot moves from full right to left of screen.	If vernier does not move dot full width of screen, make adjustments under FREQUENCY INSTRUCTION (see Performance Verification, step 8).		8
17	Return SWEEP RATE to FAST, and vernier full clockwise.				
18	Plug in second log. amplifier plug-in. Adjust DISPLAY POSITION control on second amplifier plug-in. NOTE: This checks clock and chopper in mainframe.	Two traces appear simultaneously.	If no second trace switch amplifier plug-ins in slot. If trace from same slot is missing, trouble probably in chopper in mainframe. If missing trace moves with amplifier plug-in interchange, trouble in amplifier plug-in.	Mainframe: Fig. 6-5 Log. Amplifer Plug-In: Fig. 6-14	
19	Remove second log. amplifier plug-in.				

Table 4-4. Marker, Sweep Width and Linearity Checks

STEP	ACTION	RESULT		SCHEMATIC REFERENCE	PER. VER. REFERENCE
20	Set sweeper RF OUT dBm to -20 dBm. Check that log. amplifier plug-in ON switch is off (out).				
21	Set SWEEP WIDTH to FULL and MARKER SPACING to 100 MHz. Check operation of MARKER AMPL and TILT controls.	AMPL varies marker amplitude from zero to about 0.4 division; the TILT control varies marker angle about ± 45 degrees.	If no markers appear, switch log. amplifier plug-ins. If still no markers, trouble is probably in sweeper plug-in. If other trouble, see sweeper plug-in schematic.	Log. Amplifier Plug-In: Fig. 6-14 Sweeper Plug-In: Fig. 6-7, 9	
22	Check that 15 markers appear after the start of trace.	The 15th marker should be at the extreme right edge of the trace.	Wrong number of markers, or incorrectly spaced. Do all steps from 7A through 11K, under performance verification checks.		7 through 11
23	Vary CENTER FREQUENCY control from 0 to 1500 MHz.	Variable marker moves full width of trace.	If marker does not move full width, do adjustments under step 11 (see performance verification checks).		11

Table 4-4. Marker, Sweep Width and Linearity Checks (con't)

STEP	ACTION	RESULT	COMMENT OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
24	Set SWEEP WIDTH and MARKER SPACING both to 100 MHz. Set CENTER FREQUENCY control to 500 MHz.				
25	Use CENTER FREQUENCY vernier to exactly center 500 MHz marker onto center graticule.	Check that markers appear at each major division, ± one small division.	If out of specification, perform all steps 11A through 11K. (Performance Verification)		11
26	Set CENTER FREQUENCY dial on each 100 MHz step in turn. NOTE: Although spec is ± 35 MHz, calibration is typically within 15 MHz.	Check that 100 MHz marker remains within ± 35 MHz of center line of graticule. (It may be convenient to set SWEEP WIDTH to 25 MHz.)	If out of specification, perform all steps 11A through 11K. (Performance Verification)		11
27	Set SWEEP WIDTH to FULL and MARKER SPACING to 100 MHz. Select a 100 MHz marker which is exactly on a major division line. Adjust CENTER FREQUENCY dial so variable marker is on that marker.	NOTE: Select marker at 300, 600, 900 or 1200 MHz.	If out of specification, perform all steps 11A through 11K. (Performance Verification)		11
28	Set SWEEP WIDTH to 100 MHz, and then to 1 MHz, using center frequency vernier to exactly center the 100 MHz marker each time.		If out of specification, perform all steps 11A through 11K. (Performance Verification)		11
29	Select MARKER SPACING of 1 MHz.	Check that a) 1 MHz markers are within one major division (± 1 MHz) of correct position, and b) that the center marker is four tiers high.	a) If out of specification, perform all steps 11A through 11K. b) If center marker not 4 tiers high, change both the SWEEP WIDTH and MARKER SPACING and check that all markers are present. If not, trouble is in Marker Generator circuit.	b) Fig. 6-9	a) 11
30	Vary setting of MARKER WIDTH (screw driver adjustment).	Marker width varies.	If width of marker does not change, the fault is probably in the Marker Section.	Fig. 6-9	
31	Set SWEEP WIDTH to 5 MHz and the MARKER SPACING to 1 MHz. Run WIDTH VERNIER control to full counter-clockwise position.	Observe that spacing between markers is two divisions or greater.	If spacing is less than two divisions, the fault is probably in the Frequency Instruction circuits.	Fig. 6-7	
32	Return WIDTH VERNIER to CAL position.				
33	Set sweeper plug-in controls as follows:	CENTER FREQUENCY 100 MHz Vernier (straight up) MARKER SPACING OFF	NOTE: If the system has two log. amplifier plug-ins, both should be plugged in and allowed to warmup for at least 15 minutes before proceeding with the tests.		

Table 4-4. Marker, Sweep Width and Linearity Checks (con't)

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
33 con't		SWEEP WIDTH FULL SWEEP RATE FAST Vernier (Centered) TRIGGER AUTO WIDTH VERNIER CAL RF OUT dBm 0 dBm Vernier (at 3 o'clock)			

Table 4-5. Attenuator, Offset, Power Tests (with Model 640E, T)

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
	NOTE: If system uses the Model 640R and T plug-ins, the transmission model (T) is checked first (Table 4-5), and then the 640R model is checked (Table 4-6). If the system uses two 640E models, one plug-in is checked in Table 4-5, and the second in Table 4-6. The linear amplifier plug-in (640L) is checked last (Table 4-7).				
34	Set the log. amplifier plug-in controls as follows: OFFSET, ± OFFSET 00.0 dB ON (out = off) dBm/dB dBm dB/DIV .2 dB SMOOTHING OFF DISPLAY POSITION (center reference trace) NOTE: On second log. amplifier plug-in, turn the DISPLAY POSITION full CCW.				
35	Connect short cable from RF OUT of sweeper plug-in to RF INPUT of Model 640T.				

Table 4-5. Attenuator, Offset, Power Tests(con't)

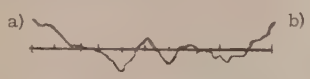
STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
35 con't	If system uses a Model 640E, connect a WILTRON Model 7 Series RF detector between sweeper output and amplifier input.				
36	Press in the ON button (only on the log. amplifier plug-in under test).	Second trace appears.	Use BEAM FINDER and OFFSET to locate second trace. If found down in noise (-50 dB), there may be no RF from sweeper (use 2nd amplifier plug-in to check). If second trace is exactly at zero level (use sweep rate on slow to check if retrace is same level as trace), then the trouble is in amplifier plug-in, forward of the ON switch (trace with markers present in previous tests, so marker amplifiers and unblank circuit o.k.).	Sweeper: Fig. 6-10 Log. Amplifier Plug-In: Fig. 6-13, Fig. 6-14	
37	Use the sweeper SLOPE control to obtain best leveling of trace. 	SLOPE control should have sufficient range to reverse slope of RF Power level. (To level, SLOPE should be adjusted so point a) and point b) are at same level.	If SLOPE control does not work, or has insufficient range, trouble is probably in the 640G RF sweeper plug-in.	Fig. 6-10	
38	Use the OFFSET controls to lay the lowest point of the trace on the zero reference line.	The OFFSET should not read more than ± 0.2 dB (this assumes the amplifier is paired with the same RF Detector used in the original calibration).	If calibration is off, perform power adjustments listed in steps 12A through 12U (of Performance Verification). NOTE: This procedure assumes: a) the log. amplifier plug-in is in calibration, and b) the DET SLOPE adjustment (R31) in amplifier is correctly set. If there is any question, check RF power from sweeper plug-in with a Power Meter. The effect of the DET SLOPE adjustment can be gauged by grounding TP18 (in amplifier) during the checks.	Fig. 6-14	12
39	Return OFFSET to 00.0 dB and use RF OUT dBm vernier to align the lowest point of trace on reference.				
40	Set RF OUT dBm on sweeper to + 10 dBm and OFFSET to + 10.0 dB. Read largest excursion of power from reference line.	Largest excursion of RF power from reference should not exceed ± 0.8 dB.	If out of spec, switch amplifier plug-ins (Model 640E or T). If one within specs, fault is in other amplifier. Try Performance Verification adjustments (steps 13 - 20) on bad amplifier. If both amplifier plug-ins give out-of-spec result, fault in sweeper plug-in. If error is small, fault may be in RF attenuator. If error high (+14 dB for example), fault may be in ALC circuit.	Fig. 6-13, 6-14 Fig. 6-10	13 through 20

Table 4-5. Attenuator, Offset, Power Tests (con't)

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
41	Use CENTER FREQUENCY dial to set the variable marker on lowest part of trace (where it touches reference line).				
42	Set SWEEP WIDTH to 1 MHz, SWEEP RATE to SLOW. Set the sweep rate vernier for a sweep of approximately 20 seconds. NOTE: In the following checks, use trace for measurements (do not use retrace).				
43	Change OFFSET ± from + to -.	There should be no discernible shift in position of trace dot.	If there is a discernible shift, the fault is in R62, the OFFSET potentiometer.	Fig. 6-14	
44	Set the RF OUT dBm of sweeper plug-in to each value in sequence as shown in table below. For each setting, use the OFFSET to realign trace with reference. The second column lists the tolerances. NOTE: The accuracy of the OFFSET and RF attenuator have now been established relative to each other.	RF OUT dBm / OFFSET (dB) / Sensitivity (dB/DIV): +10 / +10 ±0.2 / .5 -10 / -10 ±0.3 / .5 -20 / -20 ±0.4 / .5 -30 / -30 ±0.6 / 1.0 -40 / -40 ±0.8 / 1.0* -50 / -50 ±1.0 / 2.0* *Set smoothing to maximum, and find average with the noise.	If an out of spec condition occurs, leave RF OUT dBm at +10 dBm, and put precision attenuator in series between sweeper and log amplifier plug-ins. Change attenuator in 10 dB steps, and correct trace movement with OFFSET as before, to determine whether error is in sweeper attenuator or in amplifier plug-in OFFSET potentiometer.	Sweeper Plug-In: Fig. 6-10 Log. Amplifier Plug-In: Fig. 6-14	
45	Return RF OUT dBm on sweeper plug-in to 0 dBm. Return OFFSET to 00.0 and SMOOTHING to OFF on log. amplifier plug-in.				
46	Set the dBm/dB switch to dB, and then use the ZERO dB SET control to re-zero trace.	Trace is realigned with the reference.	If the ZERO dB SET control does not work properly, the fault is in S4 (dBm/dB switch), or in R94 (ZERO dB SET control).	Fig. 6-14	

Table 4-5. Attenuator, Offset, Power Tests (con't)

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
47	Set sensitivity switch (dB/DIV) of amplifier plug-in to each value in sequence as shown in table below. For each value set OFFSET to value shown in second column, and change ± switch from + to -. dB/DIV — OFFSET, dB 10 — ±40.0 5 — ±20.0 2 — ± 8.0 1 — ± 4.0 .5 — ± 2.0 .2 — ± 0.8	Trace moves, in each instance, to top and then to bottom line of the graticule. The tolerance is ± the thickness of the trace. NOTE: The linearity of the amplifier, and the accuracy of the dB/DIV switch have now been checked.	If unit does not meet specifications, first check linearity of CRT system's vertical de-deflection amplifiers (see Performance Verification, steps 4A through 4G). If linearity is still off, or there is reason to question accuracy of dB/DIV switch, do the performance verification adjustments for the log. amplifier plug-ins, and in particular steps 17 through 20.		4A through 4G 17 through 20

Table 4-6. Checking the Second Log. Amplifier Plug-In (Model 640R or 640E)

NOTE

If all of the checks in Tables 4-2 through 4-5 have been completed, then the mainframe, the sweeper plug-in and one log. amplifier plug-in are known to be in good working order. Table 4-6 will then check the second log. amplifier plug-in, quickly and without unnecessary steps.

The table can also be used to quickly check a log. amplifier plug-in, even if the previous checks (Tables 4-2 through 4-5) have not been done. This assumes, of course, that the mainframe and the sweeper plug-in are both working correctly.

PROCEDURE

1. Initial setup. (See Table 4-2)
2. Turn on POWER to mainframe. Adjust INTENSITY and FOCUS as desired.
3. Begin with step 18 on the following page. Step numbers refer to steps in Tables 4-3 through 4-5 preceeding.

Table 4-6. Checking the Second Log. Amplifier Plug-In (Model 640R or 640E)

STEP*	FUNCTION OR ACTION	COMMENTS
18	Checks chopper in Mainframe, and DISPLAY POSITION control in Log. Amplifier plug-in.	See comments, step 18. If DISPLAY POSITION control does not work, fault is in log. amplifier plug-in.
19-20	Remove other log. amplifier plug-in, set sweeper.	
21	Check for presence of markers.	If markers missing, fault is in log. amplifier plug-in.
33-34	Setup for further checks.	NOTE: Model 640R omits ± switch, dBm/dB switch; use the 0.5 dB setting on the dB/DIV switch.
35	Connect RF from sweeper plug-in to log. amplifier plug-in.	For Model 640R, use rigid coax for connection.
36	Turn on, check for presence of signal trace.	Assuming sweeper plug-in previously checked or known to be working, any trouble is in amplifier plug-in.
37	Level the trace with SLOPE control.	
38	(Model 640E only) The OFFSET is used to check accuracy of amplifier plug-in as absolute power meter. NOTE: If this is not the log. amplifier plug-in the sweeper plug-in was calibrated with, the OFFSET may read as high as ±0.6 dB and be in spec.	If out of spec, and there is any question concerning accuracy of sweeper plug-in, use another power meter to check sweeper. NOTE: DO NOT PERFORM POWER ADJUSTMENTS FOR SWEEPER PLUG-IN, UNLESS SURE ERROR IS NOT IN AMPLIFIER PLUG-IN. If error in amplifier plug-in, try performance verification steps 13 - 20.
38(A)	(Model 640E only) Return OFFSET to 00.0 dB. Set dBm/dB switch to dB position.	
38(B)	(Both Model 640E and 640R) Use ZERO dB SET to align trace with reference line.	If any trouble, see comments on step 46, Table 4-5.
40	Check leveling of amplifier. NOTE: For Model 640R, leave RF OUT at 0 dBm.	Assuming sweeper plug-in is good, any fault is in amplifier plug-in.
41-42	Set up for further checks.	
43	(640E only) Check OFFSET ±.	See comments, step 43, Table 4-5.
44	Check accuracy of OFFSET control. (For Model 640R, use SMOOTHING for -30 dBm step)	Assuming sweeper plug-in is o.k., any fault is in OFFSET. (Note: omit + 10 dB, and -50 dBm steps for 640R.)
45	Setup.	
47	Check linearity and accuracy of dB/DIV.	NOTE: Model 640R can only make OFFSET in one direction. Also, delete the 0.2 dB check.

Table 4-6. Checking the Second Log. Amplifier Plug-In (Model 640R or 640E) (con't)

STEP*	FUNCTION OR ACTION	COMMENTS
47(A)	(Model 640R only) Reset OFFSET to 00.0, and dB/DIV to 10. Plug in the Model 640T and connect cable from TEST PORT of 640R to RF INPUT of 640T.	NOTE: This check is for systems having Models 640R and 640T Log. Amplifier Plug-Ins.
47(B)	Turn on Model 640T. Set dB/dBm switch to dBm, and use OFFSET to zero trace.	Insertion loss should not exceed 6.7 dB. If greater, fault is in SWR Bridge in Model 640R.
	*See Tables 4-2, 4-3 and 4-5 for instructions.	

Table 4-7. 640L Linear Amplifier Checks

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
48		NOTE: For the Following checks, only the Model 640L and 640G plug-ins should be installed in the mainframe. Allow unit and mainframe to warm up at least 1/2 hour.			
49	Set sweeper plug-in as follows: CENTER FREQUENCY: 100 MHz Vernier: Cursor straight up MARKER SPACING: OFF SWEEP WIDTH: FULL SWEEP RATE: FAST Vernier: Clockwise TRIGGER: AUTO WIDTH VERNIER: CAL RF OUT dBm: -20 dBm Vernier: Cursor at 3 o'clock				
50	Set Model 640L controls as follows: mV/DIV: 5 INPUT: GND OFFSET mV: 00.0 DISPLAY POSITION: Center trace vertically ON: Off (push in) GAIN VERNIER: CAL		If trace does not appear, or DISPLAY POSITION control does not work, press BEAM FINDER: If there is no trace, fault is in Model 640L RETRACE SWITCH; if control doesn't work, fault in R171 (it is assumed that log. amplifier plug-ins have trace, so mainframe is all right).	Fig. 6-16	
51	Set MARKER SPACING to 100 MHz and check mainframe MARKER AMPL control.	Markers appear.	If no markers appear (assuming that other amplifier plug-ins have passed this test), fault is in Marker Summing Amplifier circuit.	Fig. 6-16	
52	Set MARKER SPACING to OFF, and SWEEP WIDTH to 1 MHz.				
53	Turn on amplifier plug-in (press in ON button.)	The trace does not deflect appreciably.	If trace deflection is appreciable, the fault is either in the OFFSET potentiometer, a) or a bad OP amp., b). NOTE: If adjustments of step 23 in Performance Verification are made, complete all following checks too.	Fig. 6-16	b) step 23 A, B, and C
54	Set mV/DIV to 1000. Set INPUT to +, and connect input of amplifier plug-in to test fixture (see Table 4-1).				

Table 4-7. 640L Linear Amplifier Checks (con't)

STEP	ACTION	RESULT	COMMENTS OR TROUBLE INDICATION	SCHEMATIC REFERENCE	PER. VER. REFERENCE
55	Use DVM to set input to 1 V ± 10 microvolts. Monitor output at rear panel BNC (LEFT VERTICAL OUT).	Output reading should be 1 V ± 100 microvolts.	If output off, make adjustments of para. 4-2.4 (Performance Verification), in particular step 24.		24
56	a) Turn GAIN VERNIER full CCW. b) Reset vernier to CAL position.	a) Output falls below 20 mV.	If faulty, trouble probably in potentiometer or resistive network.	Fig. 6-16	
57	a) Set INPUT to GND and mV/DIV to 1. Adjust DISPLAY POSITION to exactly center trace vertically. b) Reset INPUT to +.				
58	Use COARSE and FINE potentiometers to get input voltage in sequence as shown in first column below. At each setting, use OFFSET control to return trace to reference line. INPUT (mV) — OFFSET (mV) 10 — 010 ± .01mV 100 — 100 ± .02mV 950 — 950 ± .2mV	Check that setting of OFFSET control is within range specified in second column. NOTE: Accuracy of OFFSET has now been checked.	If out of spec, the trouble is in the OFFSET potentiometer.		25
59	Set the input voltage to each value shown in table below, in sequence, with sensitivity set as shown. At each step, also change the polarity of both the input voltage, and the INPUT switch. INPUT (mV) — dB/mV ± 4 — 1 ± 20 — 5 ± 100 — 25 ± 400 — 100 ±1000 — 250 ±4000 — 1000	Check that in each instance the deflection is ± 4 divisions, and accurate within the thickness of one trace line. NOTE: THIS COMPLETES THE TROUBLESHOOTING CHECKS	Assuming that the log. amplifier plug-ins have passed the linearity checks, this would indicate linearity of deflection amplifiers in mainframe is o.k. Trouble must be in gain adjustments of Linear Amplifier plug-in, or in mV/DIV network.		24 and 26

SECTION V
REPLACEABLE PARTS LISTS

5-1 INTRODUCTION

This section of the manual contains alphanumeric listings of the replaceable parts available for the Model 640 RF Analyzer. These listings are by module or major subassembly, as shown in Table 5-1. Within each table parts are arranged by component type (i.e. Resistors, Capacitors, etc.).

Given in each listing are the reference designator, the part description, and the WILTRON part number. Items such as hardware, machined parts, etc., are not included although they may be ordered through us upon special request.

5-2 ORDERING REPLACEABLE PARTS

Parts for the Model 640 RF Analyzer may be ordered through your local WILTRON representative, or directly from:

WILTRON Company
825 East Middlefield Road
Mountain View, CA 94043

Telephone: (415) 969-6500
TWX: 910-379-6578

When ordering parts, give our representative complete information including the serial number of the instrument, reference designation, full part description, and the WILTRON part number.

Table 5-1. Parts List Organization

Table	Title	Page
5-2	Model 640 Main Frame	5-2
5-3	Model 640G Sweep Generator	5-16
5-4	Sweep Generator PC Assembly 640-L-4626	5-17
5-5	Model 640T Plug-In	5-20
5-6	Model 640R Plug-In	5-21
5-7	Model 640E Plug-In	5-21
5-8	Log. Amplifier PC Assembly 640-L-4625	5-22

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS

NOTE

Model 640 Main Frame replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
10582	CTS OF ASHEVILLE, INC.	MILLS GAP ROAD	SKYLAND, NC 28776
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71450	CTS CORP.	1142 W. BEARDSLEY AVE.	ELKHART, IN 46514
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION	SOUTH PARK AND JOHN STREETS	WILLIMANTIC, CT 06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76055	MALLORY CONTROLS, CO., DIV. OF MALLORY P. R., AND CO., INC.	STATE RD. 28 W., P O BOX 327	FRANKFORT, IN 46041
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91929	HONEYWELL, INC., MICRO SWITCH DIV.	CHICAGO & SPRING STS.	FREEPORT, IL 61032
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
95238	CONTINENTAL CONNECTOR CORP.	34-63 56TH ST.	WOODSIDE, NY 11377

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-1433-00	B010100	B029999	CKT BOARD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670-1433-00
A1	670-1433-01	B030000	B049999	CKT BOARD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670-1433-01
A1	670-1433-02	B050000		CKT BOARD ASSY:HIGH VOLTAGE-DEFLECTION	80009	670-1433-02
A2	670-1454-00			CKT BOARD ASSY:SINGLE BEAM AUX	80009	670-1454-00
A4	670-1339-00			CKT BOARD ASSY:LV POWER SUPPLY	80009	670-1339-00
C106	283-0684-00	B010100	B049999	CAP.,FXD,MICA DI:620PF,20%,300V	00853	0153E621G0
C106	283-0596-00	B050000		CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C115	281-0027-00	B010100	B049999X	CAP.,VAR,PLSTC:0.7-3PF,350V	72982	535-0107-4R
C116	283-0598-00	B010100	B049999	CAP.,FXD,MICA D:253PF,5%,300V	00853	D153E2530J0
C116	281-0180-00	B050000		CAP.,VAR,MICA D:18-115PF,175V	72136	T50607-2
C126	283-0596-00			CAP.,FXD,MICA D:528PF,1%,300V	00853	D153F5280F0
C136	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F201F0
C224	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J
C227	281-0537-00			CAP.,FXD,CER DI:0.68PF,20%,600V	80009	281-0537-00
C236	285-0526-00			CAP.,FXD,PLSTC:0.1UF.20%,400V	56289	410P10404
C241	283-0270-00			CAP.,FXD,CER DI:6800PF,+80-20%,4000V	56289	45C17
C242	283-0261-00			CAP.,FXD,CER DI:0.01UF,20%,4000V	56289	41C421
C248	283-0270-00			CAP.,FXD,CER DI:6800PF,+80-20%,4000V	56289	45C17
C249	283-0270-00			CAP.,FXD,CER DI:6800PF,+80-20%,4000V	56289	45C17
C251	290-0194-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100V	56289	30D106F100DC4
C252	283-0617-00			CAP.,FXD,MICA D:4700PF,10%,300V	00853	D193F472K0
C253	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C254	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z
C258	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8141N038E105Z
C259	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075 E224M
C272	283-0021-00			CAP.,FXD,CER DI:0.001UF,20%,5000V	72982	848-556-Y5S-102M
C273	283-0208-00			CAP.,FXD,CER DI:0.22UF,10%,200V	72982	8151N230 C 224K
C274	283-0104-00	B010100	B039999	CAP.,FXD,CER DI:2000PF,5%,500V	72982	811-565B202J
C274	283-0142-00	B040000		CAP.,FXD,CER DI:0.0027UF,5%,200V,(SEL)	72982	875-551B272J
C279	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J
C281	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855-558Z5U-103Z
C622	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	72982	831-500Z5D471J
C628	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C632	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C634	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C636	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	72982	855-535U2J101J
C640	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C642	281-0519-00			CAP.,FXD,CER DI:47PF,+/-4.7PF,500V	72982	308-000C0G0470K
C659	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C671	281-0593-00	B010100	B029999X	CAP.,FXD,CER DI:3.9PF,10%,500V	72982	301-000C0J0399C
C679	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C712	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C714	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J
C716	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J
C721	281-0628-00			CAP.,FXD,CER DI:15PF,5%,500V	72982	301-000C0G0150J
C810	290-0511-00			CAP.,FXD,ELCTLT:250UF,+75-10%,250V	56289	68D10464
C815	290-0510-00			CAP.,FXD,ELCTLT:6000UF,+100-10%,15V	56289	66D10327
C820	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C822	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C830	285-0629-00			CAP.,FXD,PLSTC:0.047UF,20%,100V	56289	410P47301
C837	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C839	290-0509-00			CAP.,FXD,ELCTLT:3000UF,+100-10%,50V	56289	68D10454
C842	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2
C852	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C857	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855558Z5U0103Z
C860	290-0175-00			CAP.,FXD,ELCTLT:10UF,20%,35V	56289	150D106X0035R2
C865	281-0550-00	B010100	B039999	CAP.,FXD,CER DI:120PF,10%,500V	04222	7001-1373
C865	281-0543-00	B040000		CAP.,FXD,CER DI:270PF,10%,500V	72982	301055X5P271K
C870	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C872	281-0572-00			CAP.,FXD,CER DI:6.8PF.+/-0.5PF,500V	72982	301-000C0H0689D
C875	283-0003-00			CAP.,FXD,CER DI:0.01UF,+80-20%,150V	72982	855558Z5U0103Z
C881	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C883	290-0267-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	162D105X0035CD2
C890	281-0549-00			CAP.,FXD,CER DI:68PF,10%,500V	72982	301-000U2J0680K
CR209	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR211	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR214	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR215	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR224	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR239	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR241	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X
CR247	152-0409-00			SEMICOND DEVICE:SILICON,12,000V,5MA	83003	VG12X
CR253	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	80009	152-0414-00
CR255	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR256	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR262	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR264	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR269	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR620	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR620	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR658	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR658	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR668	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR668	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR678	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR678	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR688	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR688	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR702	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR704	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR712	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR714	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR721	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR722	152-0185-00			SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR810	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR811	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR812	152-0107-00			SEMICOND DEVICE:SILICON.375V,400MA	80009	152-0107-00
CR813	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR815	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
CR820	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR824	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR835	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR836	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR837	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR841	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR842	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR850	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR850	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR851	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR851	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR860	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	80009	152-0066-00
CR865	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR870	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR870	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR875	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR875	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR885	152-0185-00	B010100	B049999	SEMICOND DEVICE:SILICON,40PIV,150MA	07910	1N4152
CR885	152-0141-02	B050000		SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR890	151-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
DS271	150-0030-00			LAMP,GLOW:	08806	A2B-T
DS272	150-0030-00			LAMP,GLOW:	08806	A2B-T
DS273	150-0030-00			LAMP,GLOW:	08806	A2B-T
F201[1]	159-0003-00			FUSE,CARTRIDGE:3AG,1.6A,250V,SLOW-BLOW	71400	MDX16-10
F201[2]	159-0019-00			FUSE,CARTRIDGE:3AG,1A,250V,SLOW BLOW	71400	MDL1
F810	159-0028-00			FUSE,CARTRIDGE:3AG,0.25A,250V,FAST-BLOW	71400	AGC 1/4
F835	159-0025-00			FUSE,CARTRIDGE:3AG,0.5A,250V,FAST-BLOW	71400	AGC 1/2
J210	131-0955-00			CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE	24931	28JR200-1
J601	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
J602	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
J603	131-1078-00			CONNECTOR,RCPT,:28/56 CONTACT	95238	K600-11-56Y25
J604	131-1043-00			CONNECTOR,RCPT,:18/36	05574	2VK18D/2-2
L259	108-0564-00			COIL,RF:FIXED,74UH	80009	108-0564-00
L291	108-0644-00			COIL,TUBE DEFLE:TRACE ROTATION	80009	108-0644-00
Q104	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q104	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q106	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q106	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q114	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q114	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q116	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q116	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q124	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q124	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q126	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q126	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q134	151-0279-00	B010100	B079999	TRANSISTOR:SILICON,NPN	80009	151-0279-00
Q134	151-0150-00	B080000		TRANSISTOR:SILICON,NPN	80009	151-0150-00
Q136	151-0190-02	B010100	B069999	TRANSISTOR:SILICON,NPN	80009	151-0190-02
Q136	151-0190-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q138	151-0341-00	XB050000		TRANSISTOR:SILICON,NPN	07263	S040065
Q214	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q222	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q226	151-0179-00	B010100	B069999	TRANSISTOR:SILICON,NPN	03508	X16X2069
Q226	151-0347-00	B070000		TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q234	151-0228-00	B010100	B069999	TRANSISTOR:SILICON,PNP,SEL FROM 2N4888	80009	151-0228-00
Q234	151-0350-00	B070000	B072987	TRANSISTOR:SILICON,PNP	80009	151-0350-00

[1] Domestic
[2] Export

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q234	151-0406-00	B072988		TRANSISTOR:SILICON,PNP,SEL FROM 2N5401	80009	151-0406-00
Q252	151-0256-00			TRANSISTOR:SILICON,NPN	80009	151-0256-00
Q262	151-0207-00			TRANSISTOR:SILICON,NPN	80009	151-0207-00
Q264	151-0342-00			TRANSISTOR:SILICON,PNP	80009	151-0342-00
Q278	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q620	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q626	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q630	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q650	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q658	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q660	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q668	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q670	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q678	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q680	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q688	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q701	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q702	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q703	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q704	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q711	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q712	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q713	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q714	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q721	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q722	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q815	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q815	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q820	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q825	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q840	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q840	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q845	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q850	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q860	151-0331-00	B010100	B070028	TRANSISTOR:SILICON,NPN	80009	151-0331-00
Q860	151-0496-00	B070029		TRANSISTOR:SILICON,NPN	80009	151-0496-00
Q865	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q870	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q875	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q885	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q890	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
R101	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R102	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R102	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R103	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R104	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	NS5B-B750R0F
R106	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F
R108	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R112	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R112	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R113	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R114	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	MS5B-B750R0F

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R115	316-0470-00	XB030000	B049999X	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R116	311-1132-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.5W	73138	91D-B100
R118	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R122	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R122	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R123	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R124	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	NS5B-B750R0F
R125	303-0751-00			RES.,FXD,CMPSN:750 OHM,5%,1W	01121	GB7515
R126	321-0128-00			RES.,FXD,FILM:210 OHM,1%,0.125W	91637	MFF1816G210R0F
R128	308-0539-00			RES.,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R132	316-0470-00	B010100	B029999	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R132	316-0221-00	B030000		RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R133	316-0390-00	XB030000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R134	308-0668-00			RES.,FXD,WW:6.2K OHM,3%,7W	91637	NS5B-B750R0F
R135	316-0470-00	XB030000	B049999X	RES.,FXD,CMPSN:47 OHM,10%,0.25W	01121	CB4701
R135	316-0390-00	XB080000		RES.,FXD,CMPSN:39 OHM,10%,0.25W	01121	CB3901
R136	311-1132-00			RES.,VAR,NONWIR:TRMR,100 OHM,0.5W	73138	91D-B100
R138	308-0539-00			RES ,FXD,WW:2.25K OHM,0.5%,3W	91637	RS2BK22500D
R140	316-0225-00	XB050000		RES.,FXD,CMPSN:2.2M OHM,10%,0.25W	01121	CB2251
R200	311-1160-00			RES.,VAR,NONWIR:100K OHM,20%,1W	80009	311-1160-00
R202	315-0563-00			RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R203	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R206	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R207	316-0822-00			RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221
R208	316-0473-00			RES.,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R209	316-0224-00	XB050000		RES.,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R211	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R213	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R215	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R216	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R217	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R218	316-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R219	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R222	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R223	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R226	316-0101-00	XB050000		RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R227	321-0399-00			RES.,FXD,FILM:140K OHM,1%,0.125W	91637	MFF1816G14002F
R231	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R232	316-0274-00			RES.,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R234	304-0223-00			RES.,FXD,CMPSN:22K OHM,10%,1W	01121	GB2231
R236	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R239	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R242	316-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R243	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R245	311-1135-00	B010100	B029999	RES.,VAR,NONWIR:TRMR,1 MEG OHM 0.25W	71450	201-YA5535
R245	311-1205-00	B030000		RES.,VAR,NONWIR:TRMR,2 MEG OHM,0.25W	71450	201-YA5545
R248	316-0223-00			RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R251	307-0058-00			RES.,FXD,CMPSN:5.6 OHM,5%,0.5W	01121	EB56G5
R252	308-0075-00			RES.,FXD,WW:100 OHM,5%,3W	91637	RS2B-B100ROJ
R254	308-0690-00			RES.,FXD,WW:3 OHM,10%,3W	91637	RS2B-DER000K
R257	306-0104-00			RES.,FXD,CMPSN:100K OHM,10%,2W	01121	HB1041
R262	302-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,050W	01121	EB4721
R263	316-0183-00			RES.,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R266	316-0334-00			RES.,FXD,CMPSN:330K OHM,10%,0.25W	01121	CB3341
R267	316-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R268	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R269	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R270	316-0223-00	XB060000		RES.,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R271	316-0395-00			RES.,FXD,CMPSN:3.9M OHM,10%,0.25W	01121	CB3951
R272A, R272B, R272C, R272D, R272E	307-0296-00			RES.,FXD,FILM:	80009	307-0296-00
R273	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R274	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R275	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R276	316-0105-00			RES.,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R278	316-0562-00			RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621
R279	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R282	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R285	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R286	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	201-YA5536
R287	301-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.50W	01121	EB1835
R291	311-1189-00			RES.,VAR,WW:PNL,5K OHM,2W	10582	AW3349
R295	311-0254-00			RES.,VAR,NONWIR:5M OHM,10%,1W	12697	381-CM29709
R620	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R621	316-0222-00			RES.,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221
R622	315-0223-00	B010100	B029999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R622	315-0163-00	B030000		RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R626	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R628	315-0223-00	B010100	B029999	RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R628	315-0183-00	B030000		RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R630	316-0474-00			RES.,FXD,CMPSN:470K OHM,10%,0.25W	01121	CB4741
R631	316-0332-00			RES.,FXD,CMPSN:3.3K OHM,10%,0.25W	01121	CB3321
R632	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R634	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R635	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R636	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R637	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R640	316-0562-00			RES.,FXD,CMPSN:5.6K OHM,10%,0.25W	01121	CB5621
R641	316-0561-00			RES.,FXD,CMPSN:560 OHM,10%,0.25W	01121	CB5611
R642	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R643	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R650	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R652	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R656	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R657	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R659	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R660	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R662	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R665	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
R666	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R667	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225

TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R670	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R671	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311
R672	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R675	311-1133-00			RES.,VAR,NONWIR:10K OHM,30%,0.25W	71450	201-YA5534
R676	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R677	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R679	316-0101-00			RES.,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R680	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R681	316-0331-00			RES.,FXD,CMPSN:330 OHM,10%,0.25W	01121	CB3311
R682	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R685	321-0159-00			RES.,FXD,FILM:442 OHM,1%,0.125W	91637	MFF1816G442R0F
R686	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R687	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R701	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R702	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R703	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R704	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R706	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R707	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R709	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R710	316-0103-00			RES.,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R712	316-0472-00			RES.,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R713	316-0332-00			RES.,FXD,CMPSN:3.3K OHM,10%,0.25W	01121	CB3321
R715	321-0402-00			RES.,FXD,FILM:150K OHM,1%,0.125W	91637	MFF1816G15002F
R716	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R717	321-0350-00			RES.,FXD,FILM:43.2K OHM,1%,0.125W	91637	MFF1816G43201F
R718	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R720	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	91637	MFF1816G10002F
R721	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R722	321-0365-00			RES.,FXD,FILM:61.9K OHM,1%,0.125W	91637	MFF1816G61901F
R723	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R724	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R810	302-0150-00			RES.,FXD,CMPSN:15 OHM,10%,0.50W	01121	EB1501
R812	304-0683-00			RES.,FXD,CMPSN:68K OHM,10%,1W	01121	GB6831
R815	308-0685-00			RES.,FXD,WW:1.5 OHM,10%,1W	75042	BW20-1R500J
R816	321-0215-00			RES.,FXD,FILM:1.69K OHM,1%,0.125W	91637	MFF1816G16900F
R818	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R820	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R822	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R824	316-0822-00			RES.,FXD,CMPSN:8.2K OHM,10%,0.25W	01121	CB8221
R826	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R827	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R830	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R832	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R834	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R841	307-0300-00			RES.,FXD,FILM:150 OHM,5%,10W	76055	7M0LNF150B
R842	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R846	316-0391-00			RES.,FXD.CMPSN:390 OHM,10%,0.25W	01121	CB3911
R847	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R850	316-0823-00			RES.,FXD,CMPSN:82K OHM,10%,0.25W	01121	CB8231
R851	302-0333-00			RES.,FXD,CMPSN:33K OHM,10%,0.50W	01121	EB3331
R852	316-0681-00			RES.,FXD,CMPSN:680 OHM,10%,0.25W	01121	CB6811
R853	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

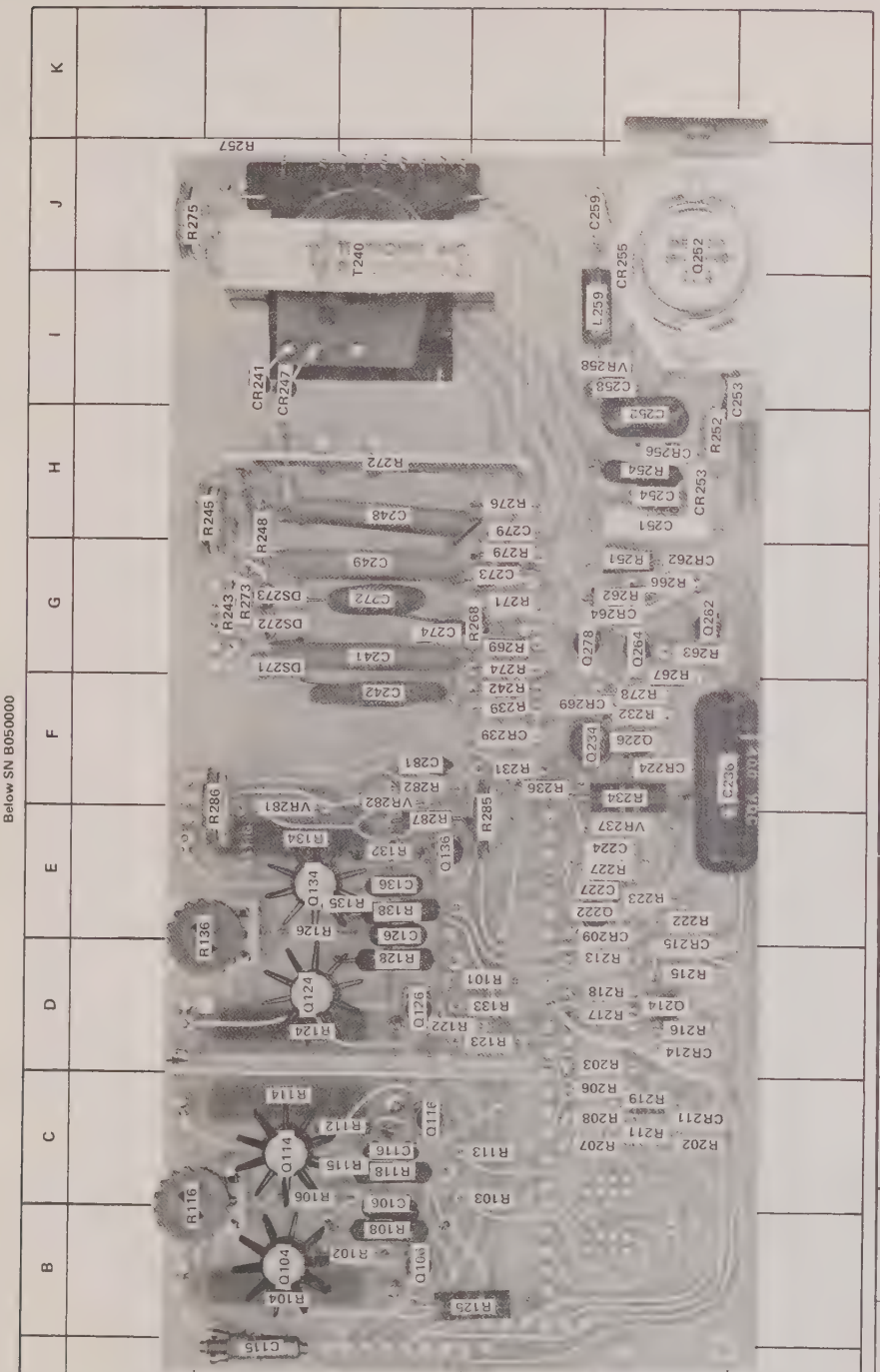
TABLE 5-2. MAIN FRAME REPLACEABLE PARTS (CONT.)

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R857	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R858	311-1120-00			RES.,VAR,NONWIR:100 OHM,30%,0.25W	71450	201-YA5531
R859	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R860	308-0686-00			RES.,FXD,WW:2.2 OHM,5%,2W	75042	BWH-2R200J
R861	307-0301-00			RES.,FXD,FILM:120 OHM,5%,10W	76055	7M0LNF150B
R863	316-0273-00			RES.,FXD,CMPSN:27K OHM,10%,0.25W	01121	CB2731
R865	315-0131-00	B010100	B039999	RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R865	315-0301-00	B040000		RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R867	315-0621-00			RES.,FXD,CMPSN:620 OHM,5%,0.25W	01121	CB6215
R868	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R869	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R870	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R872	316-0221-00			RES.,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R873	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R875	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R877	321-0256-00			RES.,FXD,FILM:4.53K OHM,1%,0.125W	91637	MFF1816G45300F
R878	311-1124-00			RES.,FXD,NONWIR:250 OHM,30%,0.25W	71450	201-YA5533
R879	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816G12400F
R880	316-0272-00			RES.,FXD,CMPSN:2.7K OHM,10%,0.25W	01121	CB2721
R881	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R883	316-0102-00			RES.,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R885	316-0153-00			RES.,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R890	322-0686-03			RES.,FXD,FILM:7.23K OHM,0.25W,0.25W	91637	MFF1421D72300C
R891	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R0C
S125	260-1238-00			SWITCH,PUSH:0.5A AT 115VAC	81073	39YY2084
S200	260-0227-00			SW,THERMOSTATIC:NC,OPEN 73.9,CL 51.7,10A	93410	110087
S201	260-1222-00			SWITCH,PUSH-PUL:10A,250VAC	91929	2DM301
T240	120-0705-01	B010100	B049999	XFMR,PWR,STU:	80009	120-0705-01
T240	120-0761-00	B050000		XFMR,PWR,STU:HV	80009	120-0761-00
T801	120-0692-00	B010100	B049999	XFMR,PWR STPDN:	80009	120-0692-00
T801	120-0704-00	B050000		XFMR,PWR SDN/SU:48-440HZ	80009	120-0704-00
U640	156-0057-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	07263	7401PC
V291	154-0633-00	B010100	B069999	ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0633-00
V291	154-0633-05	B070000		ELECTRON TUBE:CRT,P31,INT SCALE	80009	154-0633-05
V291[1]	154-0633-08			ELECTRON TUBE:CRT,P7,INT SCALE	80009	154-0633-08
V291[2]	154-0633-09			ELECTRON TUBE:CRT,P11,INT SCALE	80009	154-0633-09
VR237	152-0283-00			SEMICOND DEVICE:ZENER,0.4W,43V,5%	04713	1N976B
VR258	152-0438-00			SEMICOND DEVICE:ZENER,3W,9.1V,5%	12969	UZ709
VR281	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	1N983B
VR282	152-0255-00			SEMICOND DEVICE:ZENER,0.4W,51V,5%	04713	1N978B
VR720	152-0149-00			SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	1N961B
VR850	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	04713	1N983B
VR865	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	81483	1N965B
VR870	152-0227-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	81483	69-6585

Main Frame

[1]Option 76 only
[2]Option 78 only

DEFLECTION AMPLIFIER/HIGH-VOLTAGE BOARD
PARTS LOCATION GRID
Below SN B050000



CKT NO	GRID LOC
C106	B-3
C115	A 2
C116	C-3
C126	E-3
C136	E-3
C224	E 5
C227	E 5
C236	F-5
C241	G-3
C242	F-3
C248	H-3
C249	G 3

CKT NO	GRID LOC
C251	B-3
C252	A 2
C253	I-5
C254	H-5
C258	I-5
C259	J-4
C272	G-3
C273	G-4
C274	G-3
C279	H-4
C281	F-3

CKT NO	GRID LOC
CR209	E-5
CR211	C-5
CR214	D-5
CR215	D-5
CR224	F-5
CR239	F-4
CR241	I-2
CR247	I-2
CR252	H-5
CR253	H-5
CR255	J-4
CR256	H-5

CKT NO	GRID LOC
CR262	G-5
CR264	G-5
CR269	F-4

CKT NO	GRID LOC
VR237	E-5
VR258	I-5
VR281	F-3
VR282	F-3

CKT NO	GRID LOC
DS271	G-2
DS272	G-2
DS273	G-2

CKT NO	GRID LOC
L259	I-4

CKT NO	GRID LOC
Q104	B-2
Q106	B-3
Q114	C-2
Q116	C-3
Q124	D-2
Q126	D-3
Q134	E-2
Q136	E-3
Q214	D-5
Q222	E-5
Q226	F-5
Q234	F-4

CKT NO	GRID LOC
Q252	J-5
Q262	G-5
Q264	G-5
Q278	G-4

CKT NO	GRID LOC
R101	D-4
R102	B-3
R103	C-4
R104	B-2
R106	C-2
R108	B-3
R112	C-3
R113	C-4
R114	C-2
R115	C-3
R116	B-1
R118	C-3

CKT NO	GRID LOC
R122	D-3
R123	D-4
R124	D-2
R125	B-4
R126	E-2
R128	D-3
R132	E-3
R133	D-4
R134	E-2
R135	E-3
R136	E-2
R138	E-3

CKT NO	GRID LOC
R202	C-5
R203	D-5
R206	C-5
R207	C-5
R208	C-5
R211	C-5
R213	D-5
R215	D-5
R216	D-5
R217	D-5
R218	D-5
R219	C-5

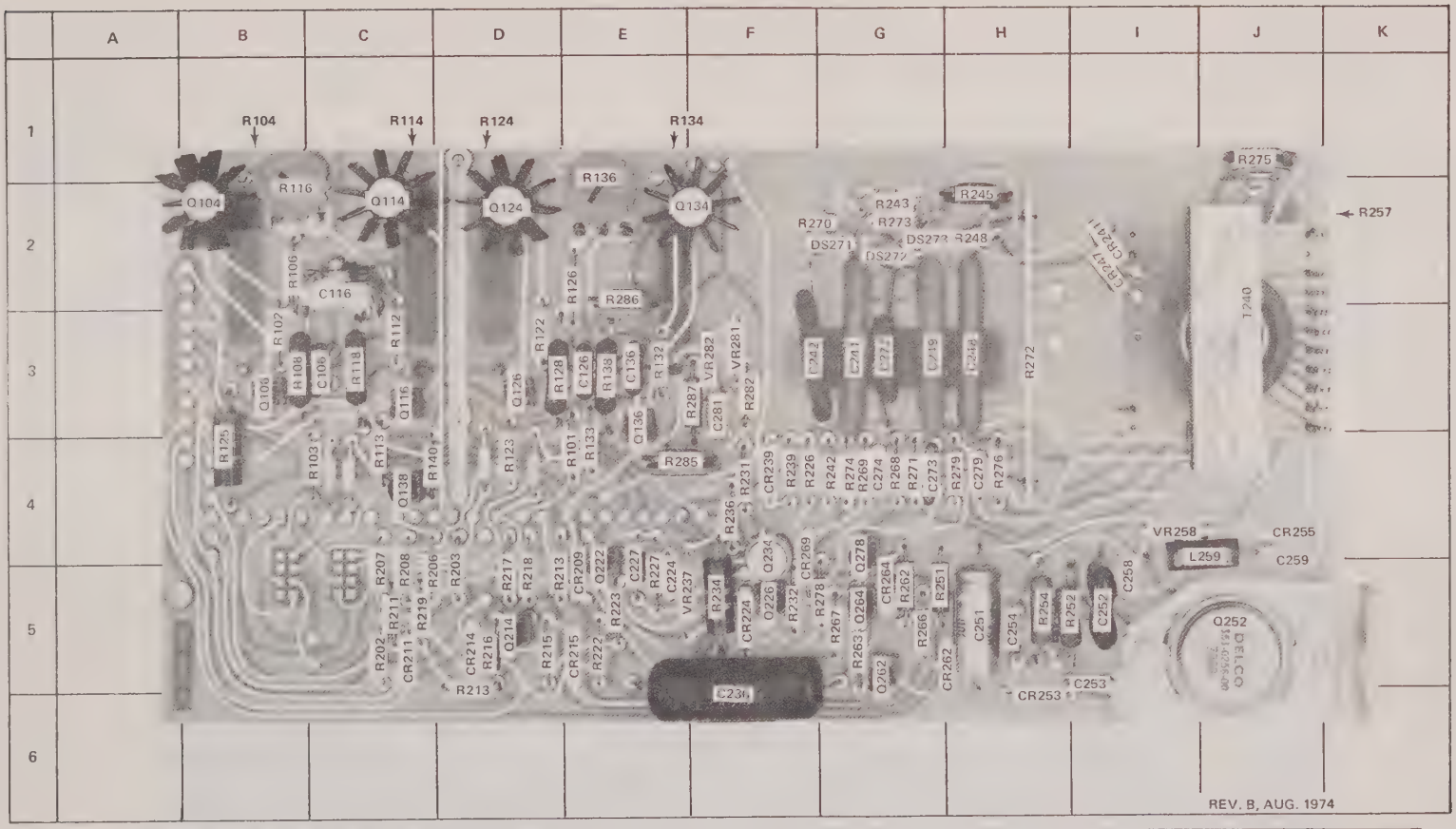
CKT NO	GRID LOC
R222	E-5
R223	E-5
R227	E-5
R231	F-4
R232	F-5
R234	F-5
R236	F-4
R239	F-4
R242	F-4
R243	G 2
R245	H-2
R248	H-2

CKT NO	GRID LOC
R251	G-5
R252	H-5
R254	H-5
R257	J-2
R262	G-5
R263	G-5
R266	G-5
R267	G-5
R268	G-4
R269	G-4
R271	G-4
R272	H-3

CKT NO	GRID LOC
R273	G-2
R274	F-4
R275	J-1
R276	H-4
R278	F-5
R279	G-4
R282	F-3
R285	E-4
R286	E-2
R287	E-3
T240	J-3

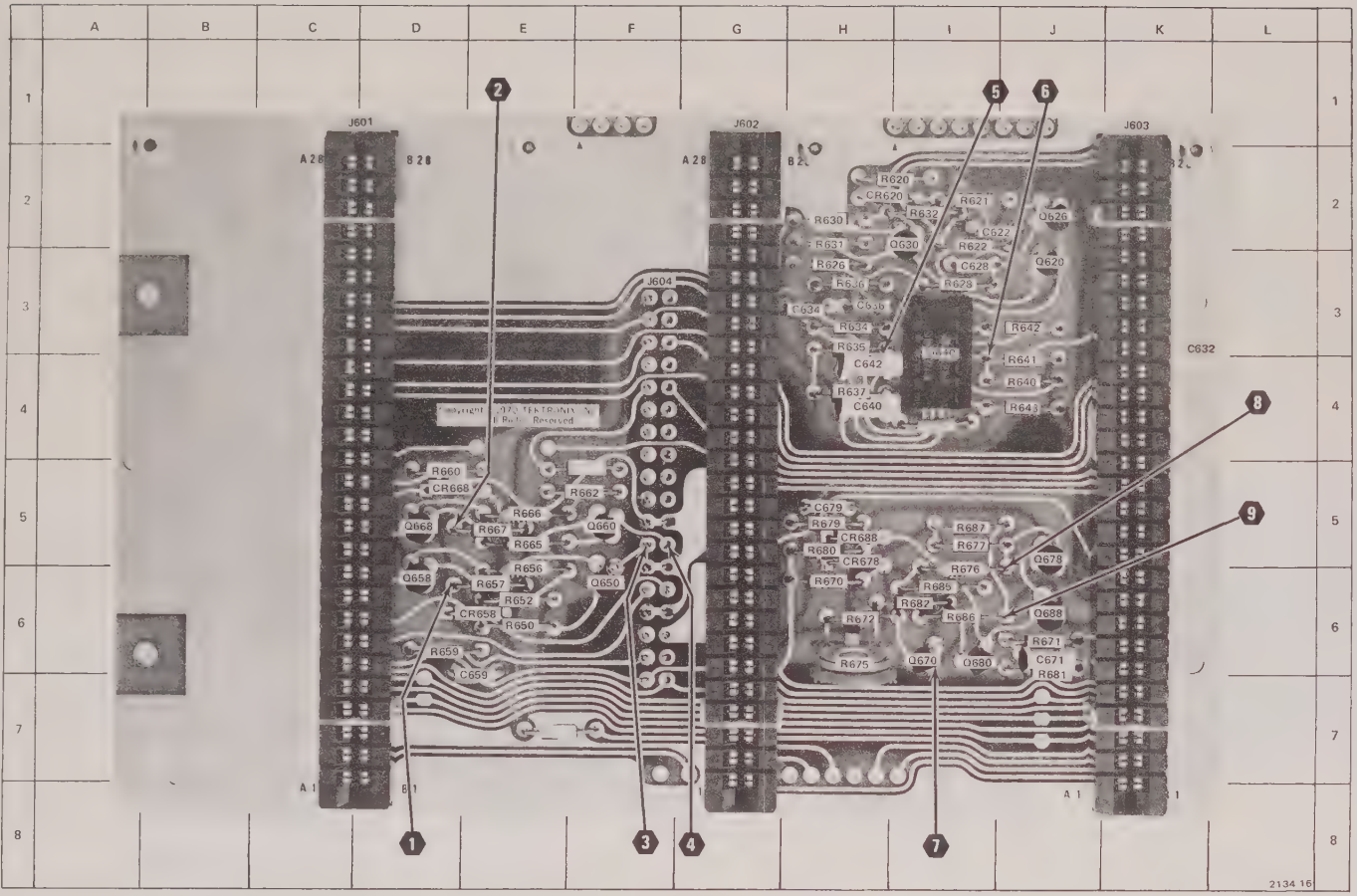
Figure 5-1. Mainframe Deflection Amplifier/High-Voltage Board, Parts Location (for Serial No. B050000 and Under)

DEFLECTION AMPLIFIER/HIGH-VOLTAGE BOARD
PARTS LOCATION GRID
Above SN B050000



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C106	C-3	C252	I-5	CR209	E-5	CR269	F-4	DS271	G-2	Q104	B-2	Q234	F-4	R101	E-4	R124	D-1	R206	E-5	R223	E-5	R251	G-5	R273	G-2
C116	C-2	C253	I-5	CR211	C-5			DS272	G-2	Q106	B-3	Q252	J-5	R102	B-3	R125	B-4	R207	C-5	R226	F-4	R252	H-5	R274	G-4
C126	E-3	C254	H-5	CR214	D-5			DS273	G-2	Q114	C-2	Q262	G-5	R103	C-4	R126	E-2	R208	C-5	R227	E-5	R254	H-5	R275	J-1
C136	E-3	C258	I-5	CR215	E-5					Q116	C-3	Q264	G-5	R104	B-1	R128	D-3	R209	D-5	R231	F-4	R257	J-2	R276	H-4
C224	E-5	C259	J-4	CR224	F-5					Q124	D-2	Q278	F-4	R106	B-2	R132	E-3	R211	C-5	R232	F-5	R262	G-5	R278	G-5
C227	E-5	C272	G-3	CR239	F-4					Q126	D-3			R108	B-3	R133	E-4	R213	D-5	R234	F-5	R263	G-5	R279	H-4
C236	F-5	C273	G-4	CR241	I-2					Q134	F-2			R112	C-3	R134	E-1	R215	D-5	R236	F-4	R266	G-5	R282	F-3
C241	G-3	C274	G-4	CR247	I-2	VR237	E-5	L259	J-4	Q136	E-3			R113	C-4	R136	E-2	R216	D-5	R239	F-4	R267	G-5	R285	E-4
C242	F-3	C279	H-4	CR253	H-6	VR258	I-4			Q138	C-4			R116	B-2	R138	E-3	R217	D-5	R242	G-4	R268	G-4	R286	E-2
C248	H-3	C281	F-4	CR255	J-4	VR281	F-3			Q214	D-5			R118	C-3	R140	C-4	R218	D-5	R243	G-2	R269	G-4	R287	E-3
C249	G-3			CR262	G-5	VR282	F-3			Q222	F-5			R122	D-2	R202	C-5	R219	C-5	R245	H-2	R270	G-2		
C251	H-5			CR264	G-5					Q226	F-5			R123	D-4	R203	D-5	R222	E-5	R248	H-2	R271	G-4		

Figure 5-2. Mainframe Deflection Amplifier/High-Voltage Board, Parts Location (For Serial No. B050000 and Above)



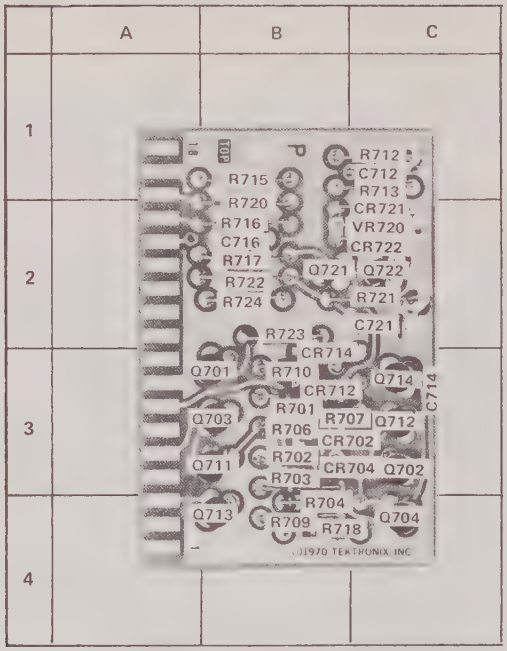
A3—Interface circuit board.

CKT NO	GRID LOC
C622	J-2
C628	I-3
C632†	K-3
C634	H-3
C636	H-3
C640	H-4
C642	H-4
C659	E-7
C671 *	J-6
C679	H 5
CR620	H-2
CR658	E-6
CR668	D-5
CR678	H-5
CR688	H-5
J601	C-1
J602	G-1
J603	K-1
J604†	F-3
Q620	J-3
Q626	J-2
Q630	I-2
Q650	F-6
Q658	D-6
Q660	F-5
Q668	D-5
Q670	I-6
Q678	J-5
Q680	I-6
Q688	J-6
R620	I-2
R621	I-2
R622	I-2
R626	H-3
R628	I-3
R630	H-2
R631	H-2
R632	I-2
R634	H-3
R635	H-3
R636	H-3
R637	H-4
R640	J-4
R641	J-4
R642	J-3
R643	J-4
R650	E-6
R651	F-5
R652	E-6
R656	E-6
R657	E-6
R659	D-6
R660	D-5
R662	F-5
R665	E-5
R666	E-5
R667	E-5
R669	E-7
R670	H-6
R671	J-6
R672	H-6
R675	H-6
R676	I 6
R677	I 5
R679	H 5
R680	H 5
R681	J 7
R682	I 6
R685	I-6
R686	I 6
R687	I 5
U640	I 3

*See Parts List for serial number ranges.

†Located on back of board.

Figure 5-3. Mainframe Interface Circuit Board, Parts Location



CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C714	C-3	Q722	C-2
C716	B-2		
C721	C-2	R701	B-3
		R702	B-3
CR702	C-3	R703	B-3
CR704	C-3	R704	B-4
CR712	B-3	R706	B-3
CR714	B-3	R707	B-3
CR721	C-2	R709	B-4
CR722	C-2	R710	B-3
		R712	C-1
VR720	C-2	R713	C-1
		R715	B-1
Q701	B-3	R716	B-2
Q702	C-3	R717	B-2
Q703	B-3	R718	B-4
Q704	C-4	R720	B-2
Q711	B-3	R721	C-2
Q712	C-3	R722	B-2
Q713	B-4	R723	B-2
Q714	C-3	R724	B-2

Figure 5-4. Mainframe Auxiliary Board, Parts Location

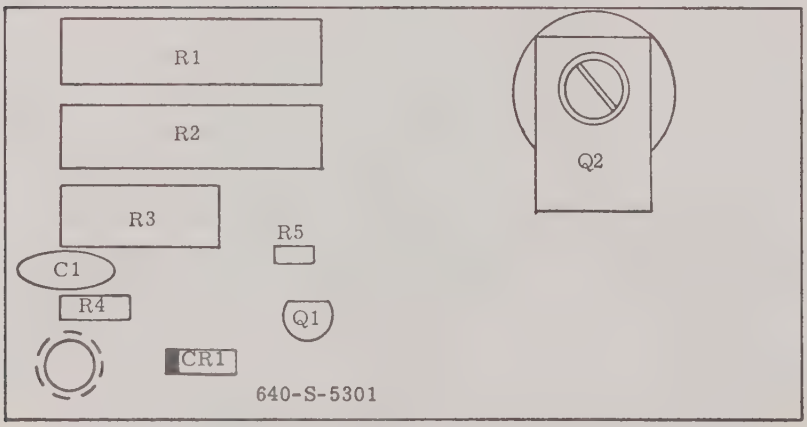
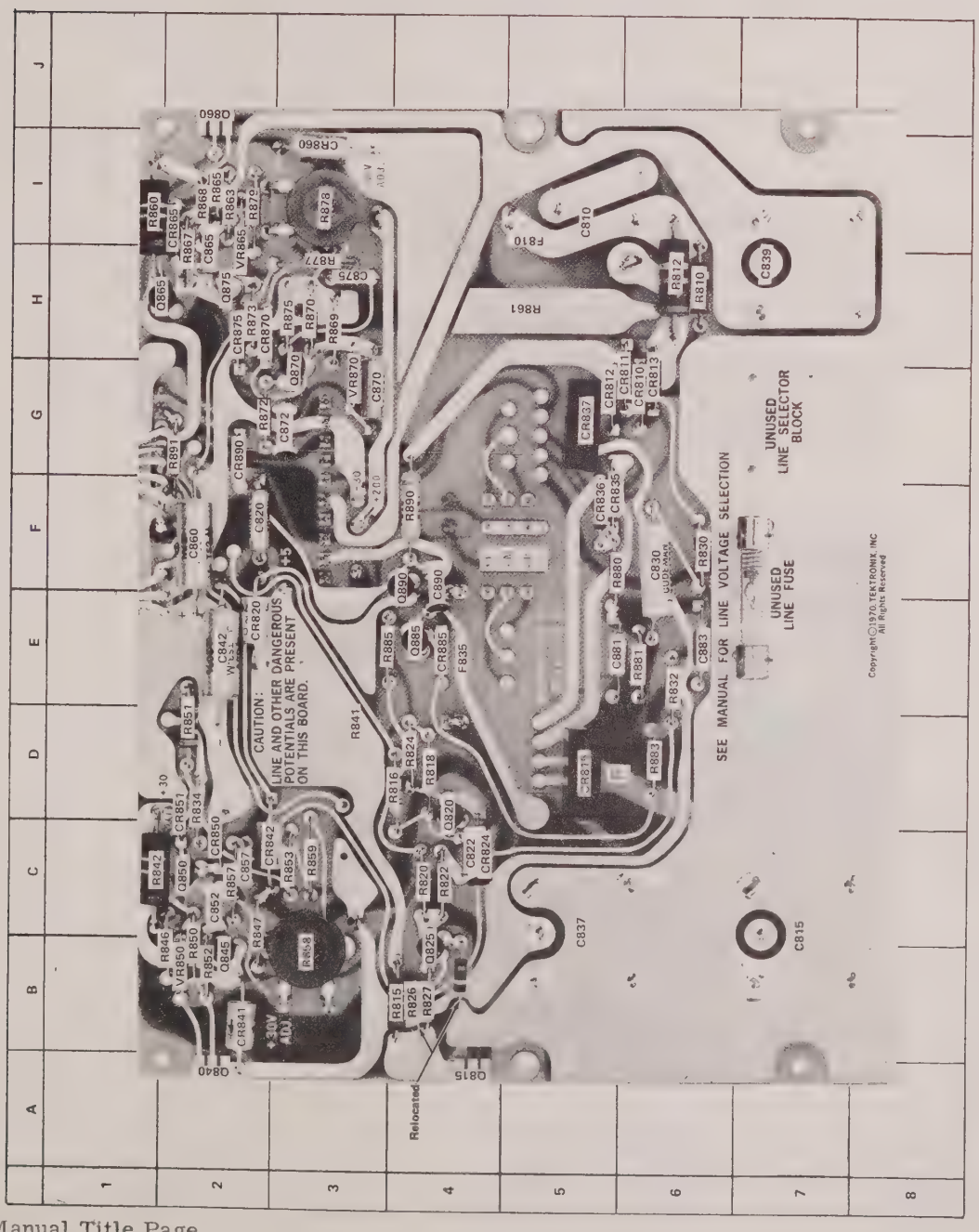


Figure 5-5A. Mainframe Interface Board Voltage Drop PC Assembly, Parts Location

Δ - See Manual Title Page
4-640-OMM


POWER SUPPLY BOARD PARTS LOCATION GRID
5103N
CAUTION:
LINE AND OTHER DANGEROUS POTENTIALS ARE PRESENT ON THIS BOARD.
SEE MANUAL FOR LINE VOLTAGE SELECTION
UNUSED LINE FUSE
UNUSED LINE SELECTOR BLOCK
Relocated
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CKT NO	GRID LOC
C810	4-5
C815	C-5
C820	F-2
C822	C-4
C830	F-6
C837	C-7
C839	H-7
C842	E-2
C852	C-2
C857	C-2
C860	F-2
C865	H-2
C870	G-3
C872	G-3
C875	H-3
C881	E-5
C883	E-6
C890	F-4
CR810	G-6
CR811	G-6
CR812	G-5
CR813	G-6
CR815	G-5
CR820	E-2
CR824	C-4
CR835	F-5
CR836	F-5
CR837	D-5
CR841	B-2
CR842	C-2
CR850	C-2
CR851	D-2
CR860	I-3
CR865	I-2
CR870	H-2
CR875	H-2
CR885	E-4
CR890	G-2
VR850	B-2
VR865	I-2
VR870	G-3
F810	I-5
F835	E-4
Q815	A-4
Q820	D-4
Q825	B-4
Q840	A-2
Q845	B-2
Q850	C-2
Q860	J-2
Q865	H-1
Q870	G-3
R810	H-6
R812	H-6
R815	B-4
R816	D-4
R818	D-4
R820	C-4
R822	C-4
R824	D-4
R826	B-4
R827	B-4
R830	E-6
R832	E-6
R834	D-2
R841	D-3
R842	C-1
R846	B-2
R847	C-2
R850	B-2
R851	D-2
R852	B-2
R853	C-3
R857	C-2
R858	B-3
R859	C-3
R860	I-1
R861	H-5
R863	I-2
R865	I-2
R867	H-2
R868	I-2
R869	H-3
R870	H-3
R872	G-2
R873	H-2
R875	H-3
R877	I-3
R878	I-3
R879	I-2
R880	F-5
R881	E-6
R883	D-6
R885	E-3
R890	F-4
R891	G-2

Figure 5-5B. Mainframe Power Supply Board, Parts Location

△ - See Manual Title Page
4-640-OMM

TABLE 5-3. MODEL 640G SWEEP GENERATOR PLUG-IN REPLACEABLE PARTS

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1A	10k variable (CENTER FREQUENCY)	149-10k
R1B	10k variable (CENTER FREQUENCY)	152-10k-1
R1C	2.32k 1/4W 1% MF (CENTER FREQUENCY)	110-2.32k-1
R2	2.5k variable (WIDTH VERNIER)	155-2.5k
R3	2.5k 2W 10% variable (SWEEP RATE)	143-2.5kA
R4	10k 1/2W 10% variable (MARKER WIDTH)	152-10kB
R5	5.90k 1/4W 1% MF (SWEEP WIDTH)	110-5.90k-1
R6	37.4k 1/4W 1% MF (SWEEP WIDTH)	110-37.4k-1
R7	196k 1/4W 1% MF (SWEEP WIDTH)	110-196k-1

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S1	Slide; 1 pole 6 position (SWEEP WIDTH)	430-55
S2	Slide; 1 pole 6 position (MARKER SPACING)	430-55
S3	Slide; 2 pole 3 position (SWEEP RATE)	430-53
S4	Slide; 3 pole 3 position (TRIGGER)	430-56
S5	Push; momentary contact (SINGLE SWEEP)	430-57

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Sweep Generator PC Assy (Table 5-4)	640-L-4626-3
---	RF Section, 50Ω	640-ML-5145-50
---	RF Section, 75Ω	640-ML-5145-75
---	Marker Section	640-ML-5225
---	Attenuator: Power Level Assy, 50Ω	640-MS-4627-1
---	10 dB Step Attenuator, 50Ω	1010-23
---	Attenuator: power Level Assy, 75Ω	640-MS-4627-2
---	10 dB Step Attenuator, 75Ω	1010-24
---	SLOPE control, R9, 1k, 1/2W	152-1kB
---	RF POWER VERNIER control, R10,	152-10kA
---	Cable Assy: SMA-BNC 50Ω	640-MS-5303-1
---	Cable Assy: SMA-BNC 75Ω	640-MS-5304-1
---	Cable Assy: BNC-M-M 50Ω UT141	640-MS-5751
---	Cable Assy: BNCM to NM 50Ω UT141	640-MS-5752
---	Cable Assy: BNC-M-M 75Ω UT141	640-MS-5753
---	Cable Assy: BNCM to NM 75Ω UT141	640-MS-5754

TABLE 5-4. SWEEP GENERATOR PC ASSEMBLY 640-L-4626 REPLACEABLE PARTS

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	.01μF, 100V, C	230-11
C2	.01μF, 100V, C	230-11
C3	27pF, 100V, M	223-27
C4	27pF, 100V, M	223-27
C5	4.7μF, 35V, T	250-39A
C6	4.7μF, 35V, T	250-39A
C7	4.7μF, 35V, T	250-39A
C8	.1μF, 250V, My	210-30
C9	.01μF, 250V, My	210-30
C10	27pF, 100V, M	223-27
C11	4.7μF, 35V, T	250-39A
C12	4.7μF, 35V, T	250-39A
C13	.01μF, 250V, My	210-30
C14	--not used--	
C15	.01μF, 100V, C	230-11
C16	2.2μF, 20V, T	250-40
C17	100μF, ±10, 20V, E	250-76
C18	4.7μF, 35V, T	250-39A
C19	.1μF, 10V, C	230-12
C20	4.7μF, 35V, T	250-39A
C21	4.7μF, 35V, T	250-39A
C22	4.7μF, 35V, T	250-39A
C23	.001μF, 1KV, C	230-3
C24	.01μF, 100V, C	230-11
C25	4.7μF, 35V, T	250-39A
C26	27pF, 100V, M	223-27
C27	4.7μF, 35V, T	250-39A
C28	4.7μF, 35V, T	250-39A
C29	27pF, 100V, M	223-27
C30	27pF, 100V, M	223-27
C31	4.7μF, 35V, T	250-39A
C32	47μF, 63V, E	250-51
C33	47μF, 63V, E	250-51
C34	.1μF, 10V, C	230-12
C35	.1μF, 10V, C	230-12
C36	4.7μF, 35V, T	250-39A
C37	10pF, 100V, M	223-10

LEGEND:

C = Ceramic
E = Electrolytic
My = Mylar
T = Tantalum
M = Mica

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	1N751A	10-1N751A
CR2	1N823	10-1N823
CR3	SI-2	10-SI-2
CR4	SI-2	10-SI-2
CR5	--not used--	
CR6	1N4446	10-1N4446
CR7	1N4446	10-1N4446
CR8	1N4446	10-1N4446
CR9	1N4446	10-1N4446
CR10	1N4446	10-1N4446
CR11	1N4446	10-1N4446
CR12	1N4446	10-1N4446
CR13	1N4446	10-1N4446
CR14	1N4446	10-1N4446
CR15	1N4446	10-1N4446
CR16	1N4446	10-1N4446
CR17	1N4446	10-1N4446
CR18	1N759A	10-1N759A
CR19	--not used--	
CR20	--not used--	
CR21	1N751A	10-1N751A
CR22	1N4446	10-1N4446
CR23	1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	2N2222A	20-2N2222A
Q2	--not used--	
Q3	2N2222A	20-2N2222A
Q4	2N3694	20-2N3694
Q5	2N3694	20-2N3694
Q6	2N3694	20-2N3694
Q7	2N4249	20-2N4249
Q8	CA3146E	54-CA3146E
Q9	CA3146E	54-CA3146E
Q10	2N3694	20-2N3694
Q11	2N4249	20-2N4249
Q12	2N3694	20-2N3694
Q13	2N4249	20-2N4249
Q14	2N3694	20-2N3694
Q15	2N3694	20-2N3694
Q16	2N3694	20-2N3694
Q17	2N4249	20-2N4249

TABLE 5-4. SWEEP GENERATOR PC ASSY 640-L-4626 REPLACEABLE PARTS (CONT.)

Q18	2N4249	20-2N4249
Q19	2N5192	20-2N5192
Q20	2N5195	20-2N5195

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	2.7Ω, 1/8W, 5% CC	100-2.7-5
R2	14.7k, 1/4W, 1% MF	110-14.7k-1
R3	5.62k, 1/4W, 1% MF	110-5.62k-1
R4	5.62k, 1/4W, 1% MF	110-5.62k-1
R5	3.48k, 1/4W, 1% MF	110-3.48k-1
R6	1k variable	156-1KA
R7	3.48k, 1/4W, 1% MF	110-3.48k-1
R8	8.25k, 1/4W, 1% MF	110-8.25k-1
R9	2.7Ω, 1/8W, 5% CC	100-2.7-5
R10	14.7k, 1/4W, 1% MF	110-14.7k-1
R11	2.87k, 1/4W, 1% MF	110-2.87k-1
R12	187Ω, 1/4W, 1% MF	110-187-1
R13	1.96k, 1/4W, 1% MF	110-1.96k-1
R14	1.96k, 1/4W, 1% MF	110-1.96k-1
R15	6.19k, 1/4W, 1% MF	110-6.19k-1
R16	5.11k, 1/4W, 1% MF	110-5.11k-1
R17	19.6k, 1/4W, 1% MF	110-19.6k-1
R18	19.6k, 1/4W, 1% MF	110-19.6k-1
R19	10k, 1/4W, 1% MF	110-10k-1
R20	2.87k, 1/4W, 1% MF	110-2.87k-1
R21	2.87k, 1/4W, 1% MF	110-2.87k-1
R22	14.7k, 1/4W, 1% MF	110-14.7k-1
R23	50k variable	156-50KA
R24	1.47k, 1/4W, 1% MF	110-1.47k-1
R25	1.47k, 1/4W, 1% MF	110-1.47k-1
R26	1k variable	156-1KA
R27	1k, 1/4W, 1% MF	110-1k-1
R28	511k, 1/4W, 1% MF	110-511k-1
R29	1.96k, 1/4W, 1% MF	110-1.96k-1
R30	100k, 1/4W, 1% MF	110-100k-1
R31	19.6k, 1/4W, 1% MF	110-19.6k-1
R32	100k, 1/4W, 1% MF	110-100k-1
R33	750k, 1/4W, 1% MF	110-750k-1
R34	23.7k, 1/4W, 1% MF	110-23.7k-1
R35	7.5k, 1/4W, 1% MF	110-7.5k-1
R36	8.25k, 1/4W, 1% MF	110-8.25k-1
R37	13.3k, 1/4W, 1% MF	110-13.3k-1
R38	19.6k, 1/4W, 1% MF	110-19.6k-1
R39	38.3k, 1/4W, 1% MF	110-38.3k-1
R40	3.32k, 1/4W, 1% MF	110-3.32k-1
R41	10k, 1/4W, 1% MF	110-101-1
R42	1k variable	156-1KA
R43	10k, 1/4W, 1% MF	110-10k-1
R44	10k, 1/4W, 1% MF	110-10k-1
R45	10k, 1/4W, 1% MF	110-10k-1
R46	19.6k, 1/4W, 1% MF	110-19.6k-1
R47	11k, 1/4W, 1% MF	110-11k-1
R48	5.11k, 1/4W, 1% MF	110-5.11k-1
R49	1M, 1/4W, 1% MF	110-1M-1A
R50	--not used--	
R51	9.09k, 1/4W, 1% MF	110-9.09k-1
R52	12.1k, 1/4W, 1% MF	110-12.1k-1
R53	4.22k, 1/4W, 1% MF	110-4.22k-1
R54	13.3k, 1/4W, 1% MF	110-13.3k-1
R55	13.3k, 1/4W, 1% MF	110-13.3k-1
R56	51.1k, 1/4W, 1% MF	110-51.1k-1
R57	5.11k, 1/4W, 1% MF	110-5.11k-1
R58	1M, 1/4W, 1% MF	110-1M-1A
R59	10k variable	156-10KA
R60	24.3k, 1/4W, 1% MF	110-24.3k-1
R61	2.37k, 1/4W, 1% MF	110-2.37k-1
R62	2.37k, 1/4W, 1% MF	110-2.37k-1
R63	19.6k, 1/4W, 1% MF	110-19.6k-1
R64	19.6k, 1/4W, 1% MF	110-19.6k-1
R65	19.6k, 1/4W, 1% MF	110-19.6k-1
R66	19.6k, 1/4W, 1% MF	110-19.6k-1
R67	10k, 1/4W, 1% MF	110-10k-1
R68	10k, 1/4W, 1% MF	110-10k-1
R69	196k, 1/4W, 1% MF	110-196k-1
R70	10k, 1/4W, 1% MF	110-10k-1
R71	19.6k, 1/4W, 1% MF	110-19.6k-1
R72	10k, 1/4W, 1% MF	110-10k-1
R73	31.6k, 1/4W, 1% MF	110-31.6k-1
R74	10k, 1/4W, 1% MF	110-10k-1
R75	10k, 1/4W, 1% MF	110-10k-1
R76	10k, 1/4W, 1% MF	110-10k-1
R77	3.83k, 1/4W, 1% MF	110-3.83k-1
R78	14.7k, 1/4W, 1% MF	110-14.7k-1
R79	19.6k, 1/4W, 1% MF	110-19.6k-1
R80	19.6k, 1/4W, 1% MF	110-19.6k-1
R81	5.62k, 1/4W, 1% MF	110-5.62k-1
R82	19.6k, 1/4W, 1% MF	110-19.6k-1
R83	14.7k, 1/4W, 1% MF	110-14.7k-1
R84	5.62k, 1/4W, 1% MF	110-5.62k-1
R85	19.6k, 1/4W, 1% MF	110-19.6k-1
R86	5.11k, 1/4W, 1% MF	110-5.11k-1
R87	1k, 1/4W, 1% MF	110-1k-1
R88	16.2k, 1/4W, 1% MF	110-16.2k-1
R89	5k variable	156-5KA
R90	1k, 1/4W, 1% MF	110-1k-1
R91	1k, 1/4W, 1% MF	110-1k-1
R92	10k variable	156-10KA
R93	56.2k, 1/4W, 1% MF	110-56.2k-1
R94	28.7k, 1/4W, 1% MF	110-28.7k-1

TABLE 5-4. SWEEP GENERATOR PC ASSY 640-L-4626 REPLACEABLE PARTS (CONT.)

R95	82.5k, 1/4W, 1% MF	110-82.5k-1
R96	10k variable	156-10KA
R97	10k, 1/4W, 1% MF	110-10k-1
R98	17.8k, 1/4W, 1% MF	110-17.8k-1
R99	10k variable	156-10KA
R100	19.6k, 1/4W, 1% MF	110-19.6k-1
R101	19.6k, 1/4W, 1% MF	110-19.6k-1
R102	19.6k, 1/4W, 1% MF	110-19.6k-1
R103	6.81k, 1/4W, 1% MF	110-6.81k-1
R104	20k variable	156-20KA
R105	100k, 1/4W, 1% MF	110-100k-1
R106	100k, 1/4W, 1% MF	110-100k-1
R107	31.6k, 1/4W, 1% MF	110-31.6k-1
R108	10M, 1/4W, 5% CC	101-10M-5
R109	2.4M, 1/4W, 5% CC	101-2.4M-5
R110	1M variable	156-1MA
R111	20k variable	156-20KA
R112	100k, 1/4W, 1% MF	110-100k-1
R113	10k, 1/4W, 1% MF	110-10k-1
R114	5.11k, 1/4W, 1% MF	110-5.11k-1
R115	10k, 1/4W, 1% MF	110-10k-1
R116	100k, 1/4W, 1% MF	110-100k-1
R117	1.96k, 1/4W, 1% MF	110-1.96k-1
R118	619Ω, 1/4W, 1% MF	110-619-1
R119	6.81k, 1/4W, 1% MF	110-6.81k-1
R120	6.81k, 1/4W, 1% MF	110-6.81k-1
R121	1M, 1/4W, 1% MF	110-1M-1A
R122	1M, 1/4W, 1% MF	110-1M-1A
R123	5.11k, 1/4W, 1% MF	110-5.11k-1
R124	14.7k, 1/4W, 1% MF	110-14.7k-1
R125	38.3k, 1/4W, 1% MF	110-38.3k-1
R126	38.3k, 1/4W, 1% MF	110-38.3k-1
R127	9.09k, 1/4W, 1% MF	110-9.09k-1
R128	14.7k, 1/4W, 1% MF	110-14.7k-1
R129	1.96k, 1/4W, 1% MF	110-1.96k-1
R130	5k variable	156-5KA
R131	9.09k, 1/4W, 1% MF	110-9.09k-1
R132	5.11k, 1/4W, 1% MF	110-5.11k-1
R133	5.11k, 1/4W, 1% MF	110-5.11k-1
R134	5.11k, 1/4W, 1% MF	110-5.11k-1
R135	50k variable	156-50KA
R136	10k, 1/4W, 1% MF	110-10k-1
R137	75k, 1/4W, 1% MF	110-75k-1
R138	61.9k, 1/4W, 1% MF	110-61.9k-1
R139	5.11k, 1/4W, 1% MF	110-5.11k-1
R140	50k variable	156-50KA
R141	16.2k, 1/4W, 1% MF	110-16.2k-1
R142	78.7k, 1/4W, 1% MF	110-78.7k-1
R143	61.9k, 1/4W, 1% MF	110-61.9k-1
R144	5.11k, 1/4W, 1% MF	110-5.11k-1
R145	5.11k, 1/4W, 1% MF	110-5.11k-1
R146	50k variable	156-50KA
R147	2.15k, 1/4W, 1% MF	110-2.15k-1
R148	75k, 1/4W, 1% MF	110-75k-1
R149	12.1k, 1/4W, 1% MF	110-12.1k-1
R150	2.15k, 1/4W, 1% MF	110-2.15k-1
R151	5.11k, 1/4W, 1% MF	110-5.11k-1
R152	50k variable	156-50KA
R153	2.15k, 1/4W, 1% MF	110-2.15k-1
R154	59k, 1/4W, 1% MF	110-59k-1
R155	12.1k, 1/4W, 1% MF	110-12.1k-1
R156	2.15k, 1/4W, 1% MF	110-2.15k-1
R157	5k variable	156-5KA
R158	6.19k, 1/4W, 1% MF	110-6.19k-1
R159	11k, 1/4W, 1% MF	110-11k-1
R160	19.6k, 1/4W, 1% MF	110-19.6k-1
R161	14.7k, 1/4W, 1% MF	110-14.7k-1
R162	20k variable	156-20KA
R163	10k, 1/4W, 1% MF	110-10k-1
R164	1k, 1/4W, 1% MF	110-1k-1
R165	--not used--	
R166	1.96k, 1/4W, 1% MF	110-1.96k-1
R167	5k variable	156-5KA
R168	9.09k, 1/4W, 1% MF	110-9.09k-1
R169	4.64k, 1/4W, 1% MF	110-4.64k-1
R170	14.7k, 1/4W, 1% MF	110-14.7k-1
R171	9.09k, 1/4W, 1% MF	110-9.09k-1
R172	5k variable	156-5KA
R173	1k, 1/4W, 1% MF	110-1k-1
R174	1.96k, 1/4W, 1% MF	110-1.96k-1
R175	19.6k, 1/4W, 1% MF	110-19.6k-1
R176	--not used--	
R177	--not used--	
R178	19.6k, 1/4W, 1% MF	110-19.6k-1
R179	19.6k, 1/4W, 1% MF	110-19.6k-1
R180	19.6k, 1/4W, 1% MF	110-19.6k-1
R181	10k, 1/4W, 1% MF	110-10k-1
R182	10k, 1/4W, 1% MF	110-10k-1
R183	2.87k, 1/4W, 1% MF	110-2.87k-1
R184	10k, 1/4W, 1% MF	110-10k-1
R185	19.6k, 1/4W, 1% MF	110-19.6k-1
R186	6.81k, 1/4W, 1% MF	110-6.81k-1
R187	5.11k, 1/4W, 1% MF	110-5.11k-1
R188	10k, 1/4W, 1% MF	110-10k-1
R189	19.6k, 1/4W, 1% MF	110-19.6k-1
R190	10k, 1/4W, 1% MF	110-10k-1
R191	19.6k, 1/4W, 1% MF	110-19.6k-1
R192	100k, 1/4W, 1% MF	110-100k-1
R193	51.1k, 1/4W, 1% MF	110-51.1k-1
R194	10k, 1/4W, 1% MF	110-10k-1
R195	19.6k, 1/4W, 1% MF	110-19.6k-1
R196	19.6k, 1/4W, 1% MF	110-19.6k-1
R197	19.6k, 1/4W, 1% MF	110-19.6k-1
R198	19.6k, 1/4W, 1% MF	110-19.6k-1

TABLE 5-4. SWEEP GENERATOR PC ASSY 640-L-4626 REPLACEABLE PARTS (CONT.)

R199	19.6k, 1/4W, 1% MF	110-19.6k-1
R200	19.6k, 1/4W, 1% MF	110-19.6k-1
R201	19.6k, 1/4W, 1% MF	110-19.6k-1
R202	19.6k, 1/4W, 1% MF	110-19.6k-1
R203	383Ω, 1/4W, 1% MF	110-383Ω-1

CC= Carbon Composition
MF= Metal Film

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	LM301A	50-LM301A
U2	LM301A	50-LM301A
U3	1458	50-1458
U4	LM318	50-LM318
U5	LM301A	50-LM301A
U6	LM301A	50-LM301A
U7	RC4136	54-RC4136
U8	--not installed--	
U9	DG200BA	50-DG200BA
U10	3302	54-3302
U11	7400	54-7400
U12	7410	54-7410
U13	7403	54-7403
U14	RC4136	54-RC4136
U15	RC4136	54-RC4136
U16	RC4136	54-RC4136
U17	7400	54-7400
U18	7472	54-7472
U19	7400	54-7400
U20	LM301A	50-LM301A
U21	LM301A	50-LM301A

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
K1	Relay, reed, DPST	690-3
S1	Switch, slide, DPDT	430-46

TABLE 5-5. MODEL 640T PLUG-IN REPLACEABLE PARTS

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R62	20kΩ, ±5%, 2W, WW (OFFSET)	150-20k
R94	10kΩ, ±5%, 2W, WW (ZERO dB SET)	150-10kA
R171	20k, ±10%, 1/2W, CC (DISPLAY POSITION)	143-20k

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S2	Slide, DP3T (SMOOTHING)	430-53
S3	Slide, DPDT (OFFSET)	430-46
S4	Slide, DPDT (ZERO dB SET)	430-46
S5	Slide, SP6T with button (dB/DIV)	430-55

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Log Amplifier PC Assy	640-L-4625-3
---	Detector Assy: 50Ω BNC Version	640-MS-4945-1
---	Detector Assy: 50Ω N Version	640-MS-4945-2
---	Detector Assy: 75Ω BNC Version	640-MS-4946-1
---	Detector Assy: 75Ω N Version	640-MS-4946-2

TABLE 5-6. MODEL 640R PLUG-IN REPLACEABLE PARTS

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R62	20kΩ ±5% 2W WW (OFFSET)	150-20k
R94	10kΩ ±5% 2W WW (ZERO dB SET)	150-10kA
R171	20k ±10% 1/2W CC (DISPLAY POSITION)	143-20k

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S2	Slide, DP3T (SMOOTHING)	430-53
S5	Slide, DP6T with button (dB/DIV)	430-55

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Log Amplifier PC Assy	640-L-4625-3
---	Autotester Assy: 50Ω BF	640-ML-4947-2
---	Autotester Assy: 50Ω NF	640-ML-4947-1
---	Autotester Assy: 75Ω BF	640-ML-4948-2
---	Autotester Assy: 75Ω NF	640-ML-4948-1

TABLE 5-7. MODEL 640E PLUG-IN REPLACEABLE PARTS

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R62	20kΩ ±5% 2W WW (OFFSET)	150-20k
R94	10kΩ ±5% 2W WW (ZERO dB SET)	150-10kA
R171	20k ±10% 1/2W CC (DISPLAY POSITION)	143-20k

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S2	Slide, DP3T (SMOOTHING)	430-53
S3	Slide, DPDT (OFFSET)	430-46
S4	Slide, DPDT (ZERO dB SET)	430-46
S5	Slide, SP6T with button (dB/DIV)	430-55

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Log Amplifier PC Assy	640-L-4625-3

TABLE 5-8. LOG. AMPLIFIER PC ASSEMBLY 640-L-4625 REPLACEABLE PARTS

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	.1μF, 250V, My	210-30
C2	.01μF, 200V, My	210-20
C3	.047μF, 400V, My	210-31
C4	4.7μF, 35V, ±20%, T	250-39
C5	4.7μF, 35V, ±20%, T	250-39
C6	4.7μF, 35V, ±20%, T	250-39
C7	4.7μF, 35V, ±20%, T	250-39
C8	.001μF, 500V, C	230-3
C9	.047μF, 400V, My	210-31
C11	.1μF, 250V, My	210-30
C12	4.7μF, 35V, ±20%, T	250-39
C13	4.7μF, 35V, ±20%, T	250-39
C14	.001μF, 500V, C	230-3
C15	.047μF, 400V, My	210-31
C17	33pF, ±5%, M	220-33
C18	4.7μF, 35V, ±20%, T	250-39
C19	47μF, 6V, T	250-9
C20	4.7μF, 35V, ±20%, T	250-39
C21	33pF, ±5%, M	220-33
C22	33pF, ±5%, M	220-33
C23	.01μF, 100V, C	230-11
C24	.01μF, 100V, C	230-11
C25	4.7μF, 35V, ±20%, T	250-39
C26	33pF, ±5%, M	220-33
C27	33pF, ±5%, M	220-33
C28	.01μF, 100V, C	230-11
C29	.01μF, 100V, C	230-11
C30	.01μF, 100V, C	230-11
C31	.01μF, 100V, C	230-11
C32	10μF, 25V, ±10%, T	250-42
C33	10μF, 25V, ±10%, T	250-42
C34	--not used--	
C35	2700pF, 100V, ±10%, C	230-34
C36	.1μF, 250V, My	210-30
C37	270pF, 300V, 5%, M	220-270

C = Ceramic
M = Mica
My= Mylar
T = Tantalum

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	1N4446, S	10-1N4446
CR2	1N4446, S	10-1N4446
CR3	1N4446, S	10-1N4446
CR4	1N4446, S	10-1N4446
CR5	1N4446, S	10-1N4446
CR6	1N4446, S	10-1N4446
CR7	1N4446, S	10-1N4446
CR8	1N4446, S	10-1N4446
CR9	1N4446, S	10-1N4446
CR10	1N4446, S	10-1N4446
CR11	1N4446, S	10-1N4446
CR12	1N4446, S	10-1N4446
CR13	1N823, Z	10-1N823
CR14	1N751A, Z	10-1N751A
CR15	1N751A, Z	10-1N751A
CR16	1N746A, Z	10-1N746A
CR17	1N758A, Z	10-1N758A

S = Silicon
Z = Zener

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	E420	20-E420
Q2	E112	20-E112
Q3	2N3565	20-2N3565
Q4	2N3565	20-2N3565
Q5	2N4249	20-2N4249
Q6	2N5195	20-2N5195
Q7	2N5192	20-2N5192
Q8	2N4249	20-2N4249
Q9	2N3694	20-2N3694
Q10	2N4249	20-2N4249
Q11	2N3565	20-2N3565
Q12	E112	20-E112
Q13	2N3565	20-2N3565

TABLE 5-8. LOG. AMPLIFIER PC ASSEMBLY 640-L-4625 REPLACEABLE PARTS (CONT.)

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	51.1k, 1/4W, 1%, MF	110-51.1k-1
R2	51.1k, 1/4W, 1%, MF	110-51.1k-1
R3	51.1k, 1/4W, 1%, MF	110-51.1k-1
R4	5k variable	156-5KA
R5	178k, 1/4W, 1%, MF	110-178k-1
R6	--not used--	
R9	100k, 1/4W, 1%, MF	110-100k-1
R10	3M, 1/4W, 5%, CC	101-3M-5
R13	20k, 1/8W, 0.1%, ±25	118-20k-1
R14	300k, 1/4W, 5%, CC	101-300k-1
R15	38.3k, 1/4W, 1%, MF	110-38.3k-1
R18	10k, 1/8W, 0.1%, ±25	118-10k-1
R19	6.49k, 1/4W, 1%, MF	110-6.49k-1
R20	--not used--	
R21	20k variable	157-20KA
R22	--not used--	
R23	10M, 1/4W, 5%, CC	101-10M-5
R25	20k, 1/8W, 0.1%, ±25	118-20k-1
R29	10k, 1/8W, 0.1%, ±25	118-10k-1
R30	150k, 1/4W, ±5%, CC	101-150k-5
R31	10k variable	156-10KA
R34	4.75k, 1/4W, 1%, MF	110-4.75k-1
R35	19.6k, 1/4W, 1%, MF	110-19.6k-1
R36	2.37k, 1/4W, 1%, MF	110-2.37k-1
R37	1.07k, 1/4W, 1%, MF	110-1.07k-1
R38	976, 1/4W, 1%, MF	110-976-1
R41	110k, 1/4W, 1%, MF	110-110-1
R42	31.6k, 1/4W, 1%, MF	110-31.6k-1
R43	500 variable	157-500A
R44	1k, 1/4W, 1%, MF	110-1k-1
R45	100, 1/4W, 1%, MF	110-100-1
R46	20k variable	157-20KA
R47	100, 1/4W, 1%, MF	110-100-1
R51	20k variable	156-20KA
R52	100, 1/4W, 1%, MF	110-100-1
R53	10.5k, 1/4W, 1%, MF	110-10.5k-1
R54	42.2Ω, 1/4W, 1% MF	110-42.2-1
R55	10.0Ω, 1/4W, 1% MF	110-10.0-1
R61	10.0k, 1/4W, 1%, MF	110-10.0k-1
R62	20k, 1/4W, 1%, MF	110-20k-1
R65	14.3k, 1/4W, 1%, MF	110-14.3k-1
R66	14.3k, 1/4W, 1%, MF	110-14.3k-1
R67	1.02k, 1/4W, 1%, MF	110-1.02k-1
R68	976, 1/4W, 1%, MF	110-976-1
R71	5k, variable	110-5k-1
R72	5k, variable	110-5k-1
R73	20.0k, 1/4W, 1%, MF	110-20.0k-1
R74	1k, 1/4W, 1%, MF	110-1k-1
R75	20k variable	157-20KA
R76	100, 1/4W, 1%, MF	110-100-1
R77	31.6k, 1/4W, 1%, MF	110-31.6k-1
R78	100, 1/4W, 1%, MF	110-100-1
R79	42.2Ω, 1/4W, 1% MF	110-42.2-1
R80	10.0Ω, 1/4W, 1% MF	110-10.0-1
R83	24.9k, 1/4W, 1%, MF	110-24.9k-1
R84	1k variable	110-1k-1
R85	1k, 1/4W, 1%, MF	110-1k-1
R86	953, 1/4W, 1%, MF	110-953-1
R90	9.53k, 1/4W, 1%, MF	110-9.53k-1
R91	100 variable	157-100A
R94	--not used--	
R95	1.02k, 1/4W, 1%, MF	110-1.02k-1
R96	976, 1/4W, 1%, MF	110-976-1
R99	8.06k, 1/4W, 1%, MF	110-8.06k-1
R100	10.0k, 1/4W, 1%, MF	110-10.0k-1
R101	4.02k, 1/4W, 1%, MF	110-4.02k-1
R102	9.09k, 1/4W, 1%, MF	110-9.09k-1
R103	1k, 1/4W, 1%, MF	110-1k-1
R104	100, 1/4W, 1%, MF	110-100-1
R105	100, 1/4W, 1%, MF	110-100-1
R106	14.7k, 1/4W, 1%, MF	110-14.7k-1
R107	15.0k, 1/4W, 1%, MF	110-15.0k-1
R108	10.0Ω, 1/4W, 1% MF	110-10.0-1
R111	--not used--	
R112	10.0k, 1/4W, 1%, MF	110-10.0k-1
R113	20.0k, 1/4W, 1%, MF	110-20.0k-1
R114	49.9k, 1/4W, 1%, MF	110-49.9k-1
R115	100k, 1/4W, 1%, MF	110-100k-1
R116	200k, 1/4W, 1%, MF	110-200k-1
R117	499k, 1/4W, 1%, MF	110-499k-1
R118	3.74k, 1/4W, 1%, MF	110-3.74k-1
R119	31.6k, 1/4W, 1%, MF	110-31.6k-1
R120*	10M, 1/4W, 5%, CC	101-10M-5
R121	2.67k, 1/4W, 1%, MF	110-2.67k-1
R122*	5.1M, 1/4W, 5%, CC	101-5.1M-5
R123	50k variable	156-50KA
R124	100k, 1/4W, 1%, MF	110-100k-1
R128*	5.1M, 1/4W, 5%, CC	101-5.1M-5
R131	--not used--	
R132*	10M, 1/4W, 5%, CC	101-10M-5
R133	50k variable	156-50KA
R134	10.0k, 1/4W, 1%, MF	110-10.0k-1
R137	--not used--	
R138	1.18k, 1/4W, 1%, MF	110-1.18k-1
R139	5.62k, 1/4W, 1%, MF	110-4.62k-1
R140	51.1k, 1/4W, 1%, MF	110-51.1k-1
R141	3.65k, 1/4W, 1%, MF	110-3.65k-1
R142	7.32k, 1/4W, 1%, MF	110-7.32k-1
R143	14.7k, 1/4W, 1%, MF	110-14.7k-1

TABLE 5-8. LOG. AMPLIFIER PC ASSY 640-L-4625 REPLACEABLE PARTS (CONT.)

R144	1k variable	157-1KA
R145	10.0k, 1/4W, 1%, MF	110-10.0k-1
R146	5.62k, 1/4W, 1%, MF	110-5.62k-1
R147	51.1k, 1/4W, 1%, MF	110-51.1k-1
R152	--not used--	
R153	10.0k, 1/4W, 1%, MF	110-10.0k-1
R156	8.25k, 1/4W, 1%, MF	110-8.25k-1
R157	5.62k, 1/4W, 1%, MF	110-5.62k-1
R158	51.1k, 1/4W, 1%, MF	110-51.1k-1
R159	10.0k, 1/4W, 1%, MF	110-10.0k-1
R160	10.0k, 1/4W, 1%, MF	110-10.0k-1
R161	10.0k, 1/4W, 1%, MF	110-10.0k-1
R162	6.81, 1/4W, 1% MF	110-6.81-1
R163	5.11, 1/4W, 1% MF	110-5.11-1
R164	14.7k, 1/4W, 1%, MF	110-14.7k-1
R165	10.0k, 1/4W, 1%, MF	110-10.0k-1
R166	10.0k, 1/4W, 1%, MF	110-10.0k-1
R167	10.0k, 1/4W, 1%, MF	110-10.0k-1
R168	51.1k, 1/4W, 1%, MF	110-51.1k-1
R169	100k, 1/4W, 1%, MF	110-100k-1
R170	10.0k, 1/4W, 1%, MF	110-10.0k-1
R171	--not used--	
R172	51.1k, 1/4W, 1%, MF	110-51.1k-1
R173	19.1k, 1/4W, 1%, MF	110-19.1k-1
R174	100, 1/4W, 1%, MF	110-100-1
R175	1k, 1/4W, 1%, MF	110-1k-1
R176	1k, 1/4W, 1%, MF	110-1k-1
R177	3.16k, 1/4W, 1%, MF	110-3.16k-1
R178	100k, 1/4W, 1%, MF	110-100k-1
R179	1k, 1/4W, 1%, MF	110-1k-1
R180	1M, 1/4W, 1%, MF	110-1M-1-A
R181	124k, 1/4W, 1%, MF	110-124k-1
R182	1M, 1/4W, 1%, MF	110-1M-1-A
R183	100, 1/4W, 1%, MF	110-100-1
R184	15.8k, 1/4W, 1%, MF	110-15.8k-1
R185	4.99k, 1/4W, 1%, MF	110-4.99k-1
R186	3.32k, 1/4W, 1%, MF	110-3.32k-1
R187	100k, 1/4W, 1%, MF	110-100k-1

CC = Carbon Composite
MF = Metal Film
* = Factory-select

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1		50-1
U3	1458	50-1458
U5	μA725C	50-μA725C
U7	μA725C	50-μA725C
U9	LM301A	50-LM301A
U10	LM301A	50-LM301A
U12	LM301A	50-LM301A
U13	LM301A	50-LM301A
U14	LM301A	50-LM301A
U15	1458	50-1458

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
S1	Switch, DPDT	430-54

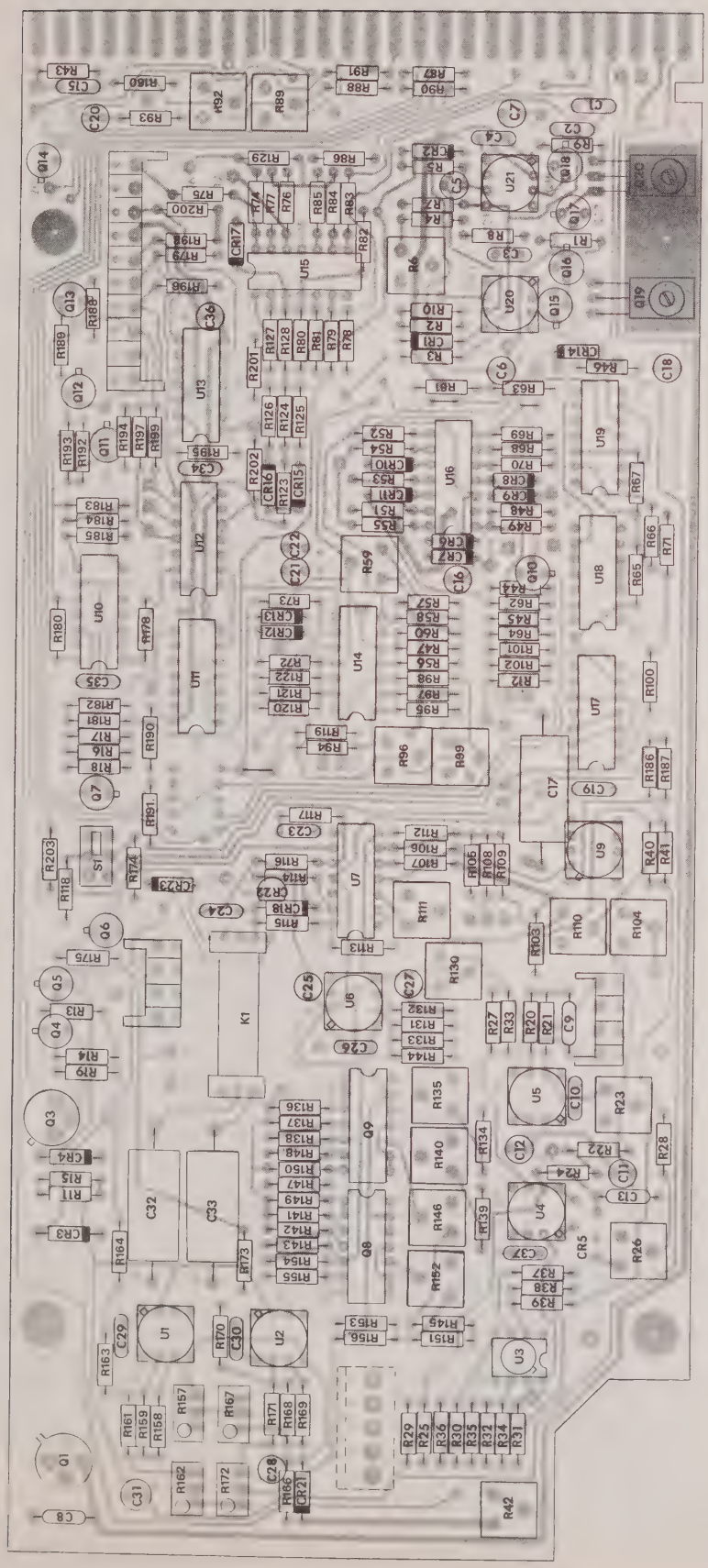


Figure 5-6. Sweep Generator PC Assembly 640-L-4626, Parts Location

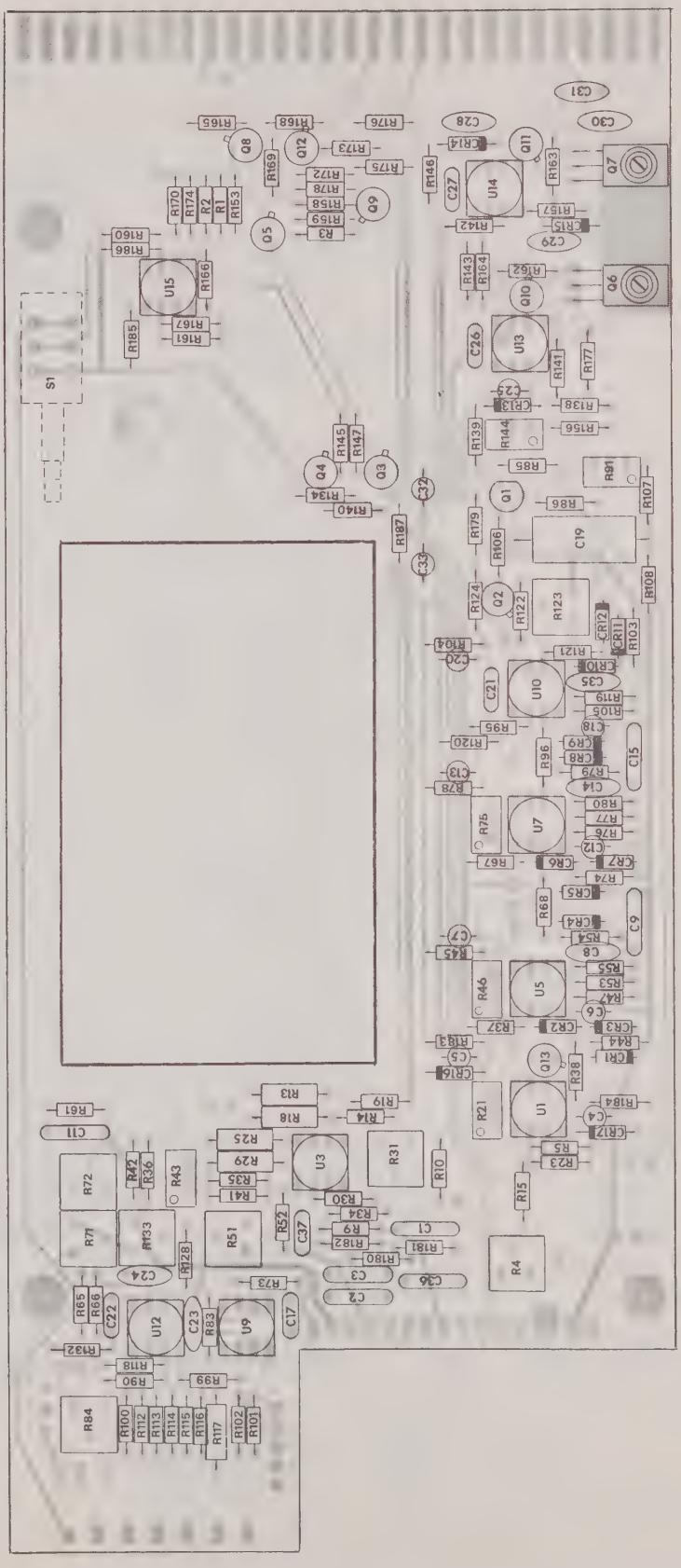


Figure 5-7. Log. Amplifier PC Assembly 640-L-4625, Parts Location

SECTION VI

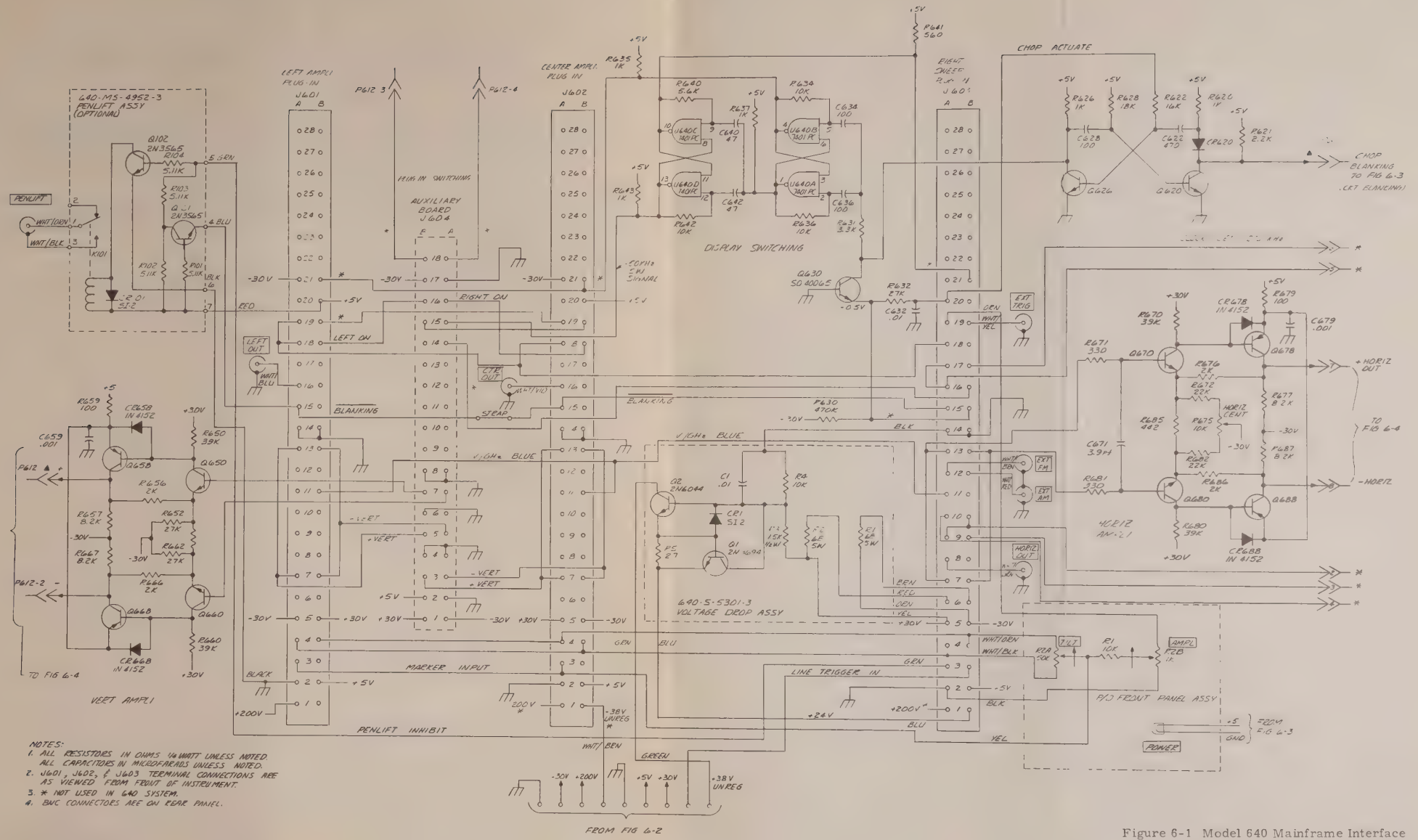
SCHEMATIC DIAGRAMS

6-1 INTRODUCTION

This section of the manual contains the schematic diagrams for the Model 640 RF Analyzer. Table 6-1 lists all the drawings included in this section of the manual.

Table 6-1. List of Drawings and Schematics

Figure	Title	Drawing No.	Page
6-1	Model 640 Mainframe Interface Board	640-100	6-3
6-2	Mainframe Low Voltage Power Supply	TEK-A4/◇5	6-5
6-3	Mainframe High Voltage Deflection Board and CRT Circuit	TEK-A1A/◇4	6-7
6-4	Mainframe Vertical and Horizontal Deflection Amplifiers	TEK-A1B/◇3	6-9
6-5	Mainframe Auxiliary Board	TEK-A2/◇2	6-11/6-12
6-6	Sweep Generator Plug-In, Ramp Generator	640G-A1/1	6-13/6-14
6-7	Sweep Generator Plug-In, Frequency Instruction	640G-A1/2	6-15/6-16
6-8	Sweep Generator Plug-In, Linearizer	640G-A1/3	6-17/6-18
6-9	Sweep Generator Plug-In, Marker Control	640G-A1/4	6-19/6-20
6-10	Sweep Generator Plug-In, ALC	640G-A1/5	6-21/6-22
6-11	Sweep Generator Plug-In, ± 15 V Regulators	640G-A1/6	6-23/6-24
6-12	Log. Plug-In, RF Components	640T, R, E-A1/4	6-25/6-26
6-13	Log. Plug-In, Preamplifier	640T, R, E-A1/5	6-27/6-28
6-14	Log. Plug-In, Processor	640T, R, E-A1/2	6-29/6-30
6-15	Log. Plug-In, ± 15 V Regulators	640T, R, E-A1/3	6-31/6-32



NOTES:
1. ALL RESISTORS IN OHMS 1/4 WATT UNLESS NOTED. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
2. J601, J602, & J603 TERMINAL CONNECTIONS ARE AS VIEWED FROM FRONT OF INSTRUMENT.
3. * NOT USED IN 640 SYSTEM.
4. BNC CONNECTORS ARE ON REAR PANEL.

Figure 6-1 Model 640 Mainframe Interface Board (640-100)

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

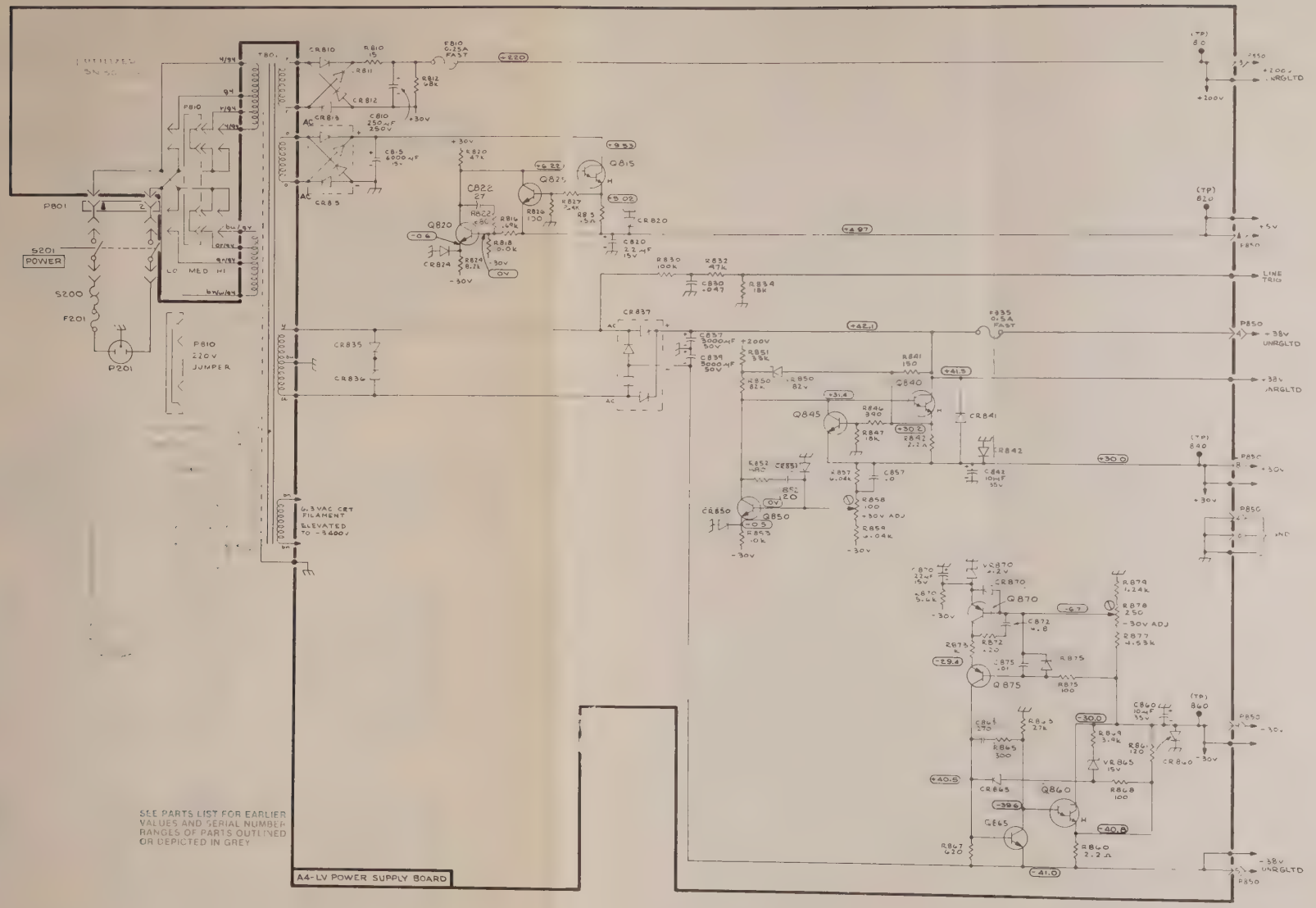


Figure 6-2. Mainframe Low Voltage Power Supply

Δ - See Manual Title Page
4-640-OMM

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

NOTE

The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.

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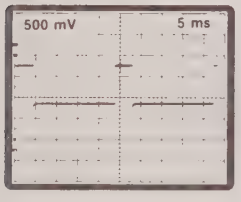

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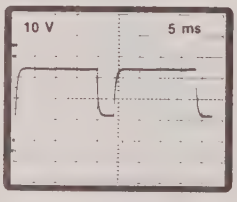

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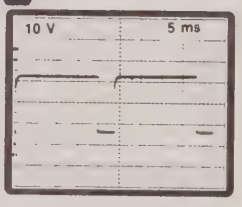

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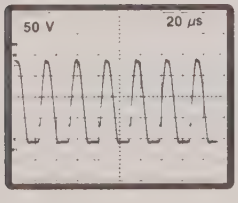

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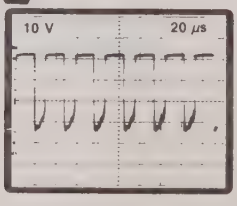

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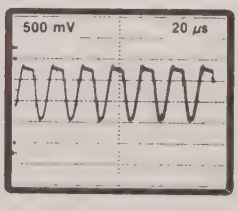


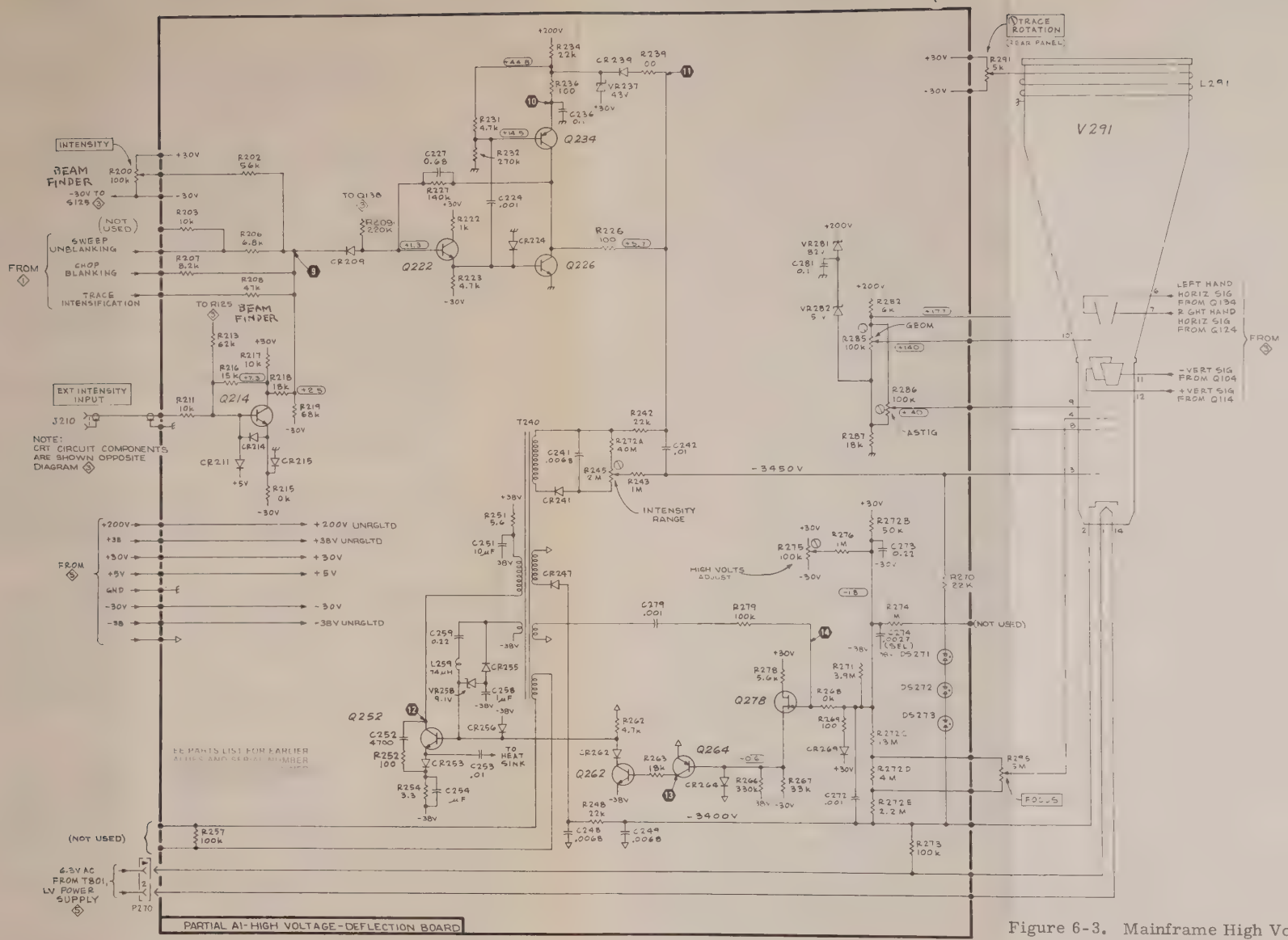


Figure 6-3. Mainframe High Voltage Deflection Board and CRT Circuit

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

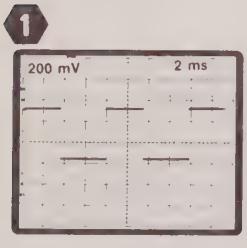
WAVEFORM CONDITIONS

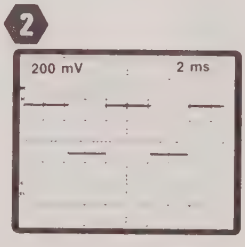
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time base unit in the horizontal compartment. Connect a 400V peak-to-peak square wave to the vertical input.

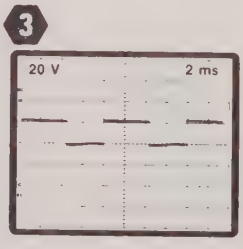
TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

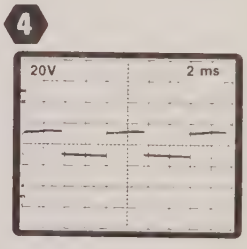
NOTE

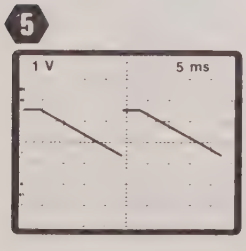
The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.

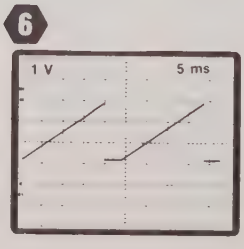


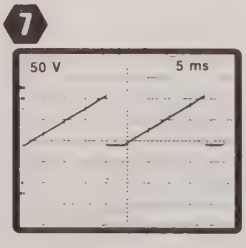


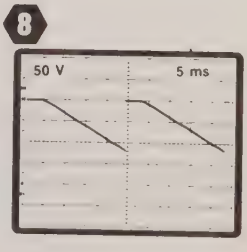












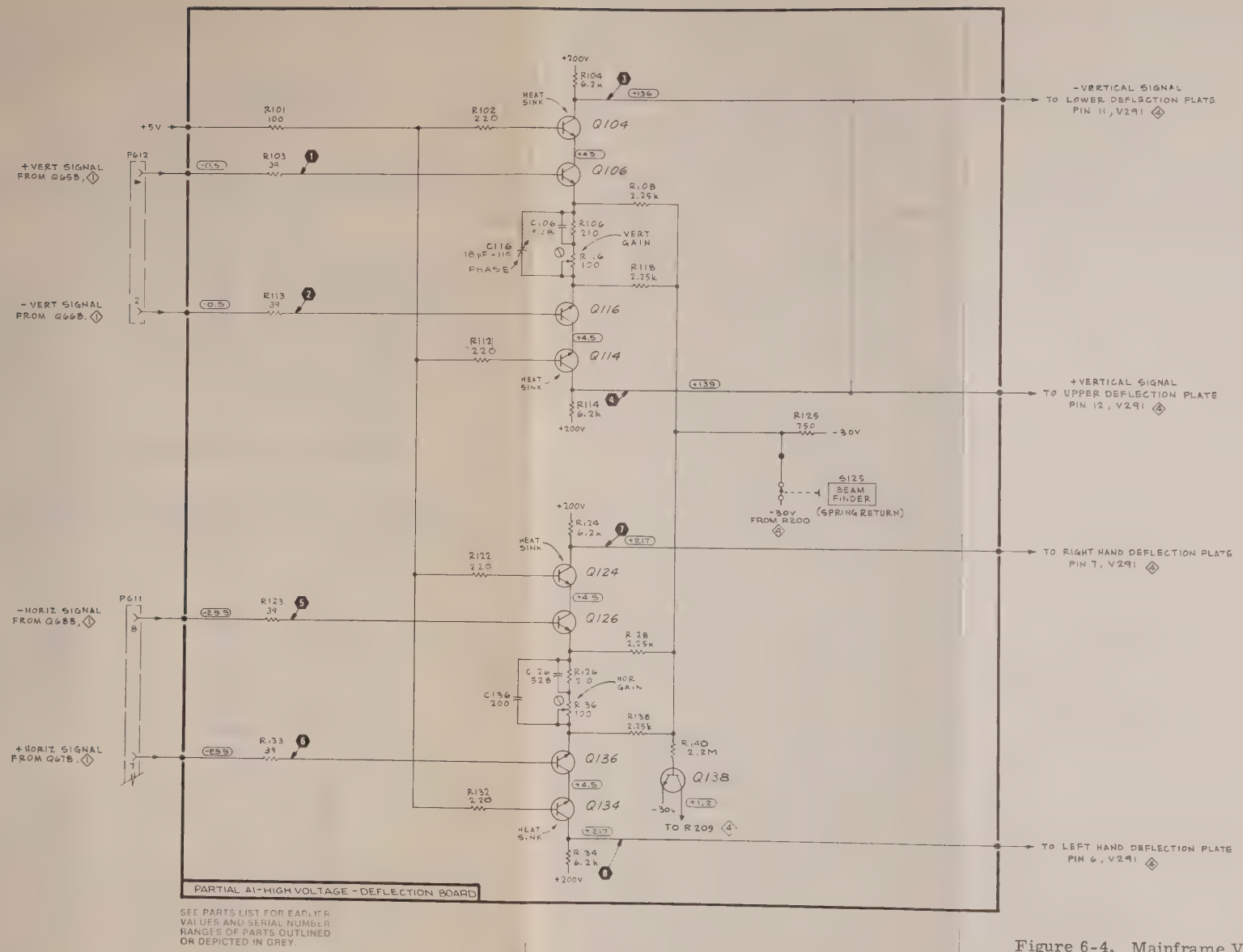


Figure 6-4. Mainframe Vertical and Horizontal Deflection Board

Δ - See Manual Title Page
4-640-OMM

VOLTAGE AND WAVEFORM CONDITIONS

WARNING

Dangerous potentials exist at several points throughout this instrument. When the instrument is operated with the covers removed, do not touch exposed connections or components. Some transistors have voltages present on their cases. Disconnect the power source before replacing parts.

RECOMMENDED TEST EQUIPMENT

Item	Specifications	Recommended Type
Test oscilloscope system	Deflection factor, 1 mV to 50 V/div; input impedance, 1 megohm; frequency response, dc to 2 MHz. Probe: 10X attenuation probe compatible with vertical input.	Tektronix 5110, 5A13N, 5B10N oscilloscope system or equiv. Use a Tektronix P6108 or P6062A Probe.
Voltmeter (Non-loading digital multimeter)	Range, 0 to 250 V; input impedance, 10 megohms.	Tektronix DM 501 Digital Multimeter with power module.

VOLTAGE CONDITIONS

Voltage measurements on this diagram were made under the following conditions:

An amplifier unit is installed in the left vertical compartment (for power supply loading). INTENSITY control is set fully ccw. Voltmeter common is connected to chassis ground.

WAVEFORM CONDITIONS

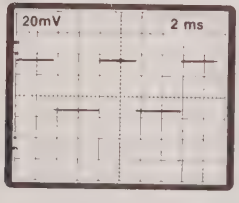
OSCILLOSCOPE UNDER TEST. Install an amplifier unit in the left vertical compartment and a time-base unit in the horizontal compartment. Connect a 400V peak-to-peak square wave to the vertical input.

TEST OSCILLOSCOPE. Set the test oscilloscope triggering for auto mode with ac coupling from the internal source and set vertical input coupling to ac. Connect a 10X Probe to the vertical input. Position the display as necessary.

NOTE

The waveforms shown are actual waveform photographs taken with a Tektronix Oscilloscope Camera System and Projected Graticule. Vertical deflection factor shown on the waveform is the actual deflection factor from the probe tip. Voltages and waveforms on the diagrams are not absolute and may vary between instruments because of component tolerances, internal calibration, or front-panel settings. Readouts are simulated in larger-than-normal type.

1



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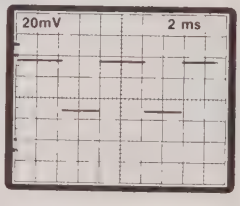

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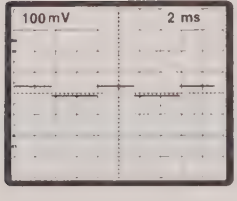

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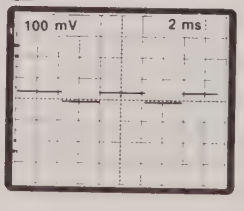
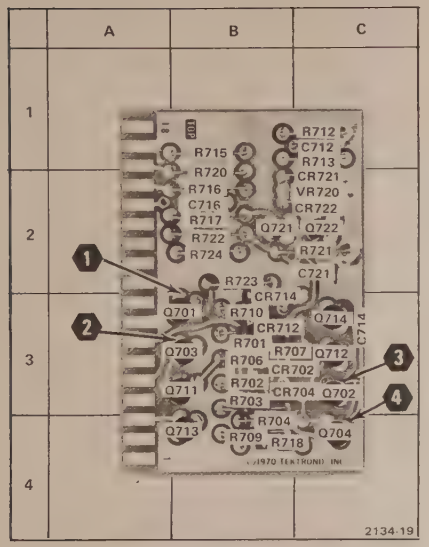


VOLTAGE & WAVEFORM CONDITIONS



A2—Single Beam Auxiliary circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC
C712	C-1	Q721	B-2
C714†	C-3	Q722	C-2
C716	B-2		
C721	C-2	R701	B-3
		R702	B-3
CR702	C-3	R703	B-3
CR704	C-3	R704	B-4
CR712	B-3	R706	B-3
CR714	B-3	R707	B-3
CR721	C-2	R709	B-4
CR722	C-2	R710	B-3
		R712	C-1
VR720	C-2	R713	C-1
		R715	B-1
Q701	B-3	R716	B-2
Q702	C-3	R717	B-2
Q703	B-3	R718	B-4
Q704	C-4	R720	B-2
Q711	B-3	R721	C-2
Q712	C-3	R722	B-2
Q713	B-4	R723	B-2
Q714	C-3	R724	B-2

†Located on back of board.

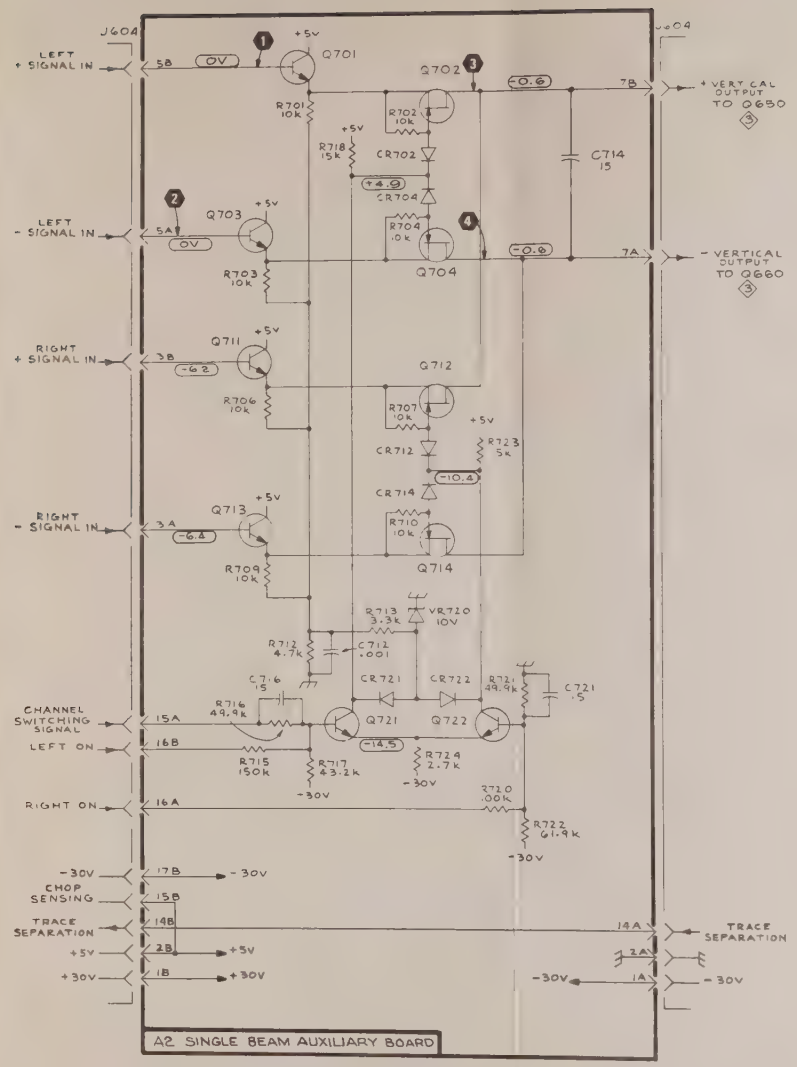
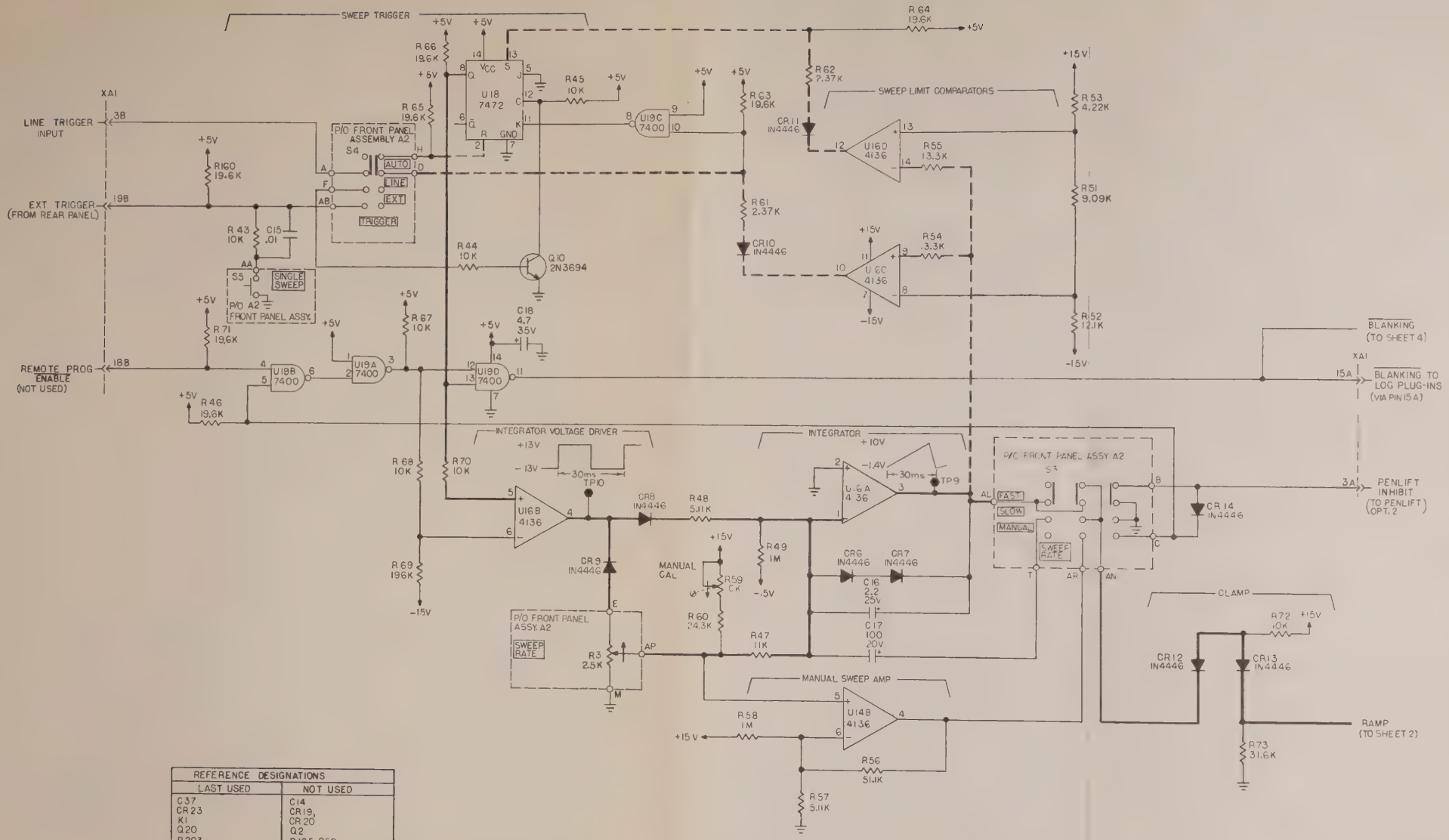


Figure 6-5. Mainframe Auxiliary Board



REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C37	C14
CR23	CR19, CR20
K1	Q2
Q20	R165, R50
R203	R176
TP21	R177
U21	

Figure 6-6 Sweep Generator Plug-In, Ramp Generator (640G-A1/1)

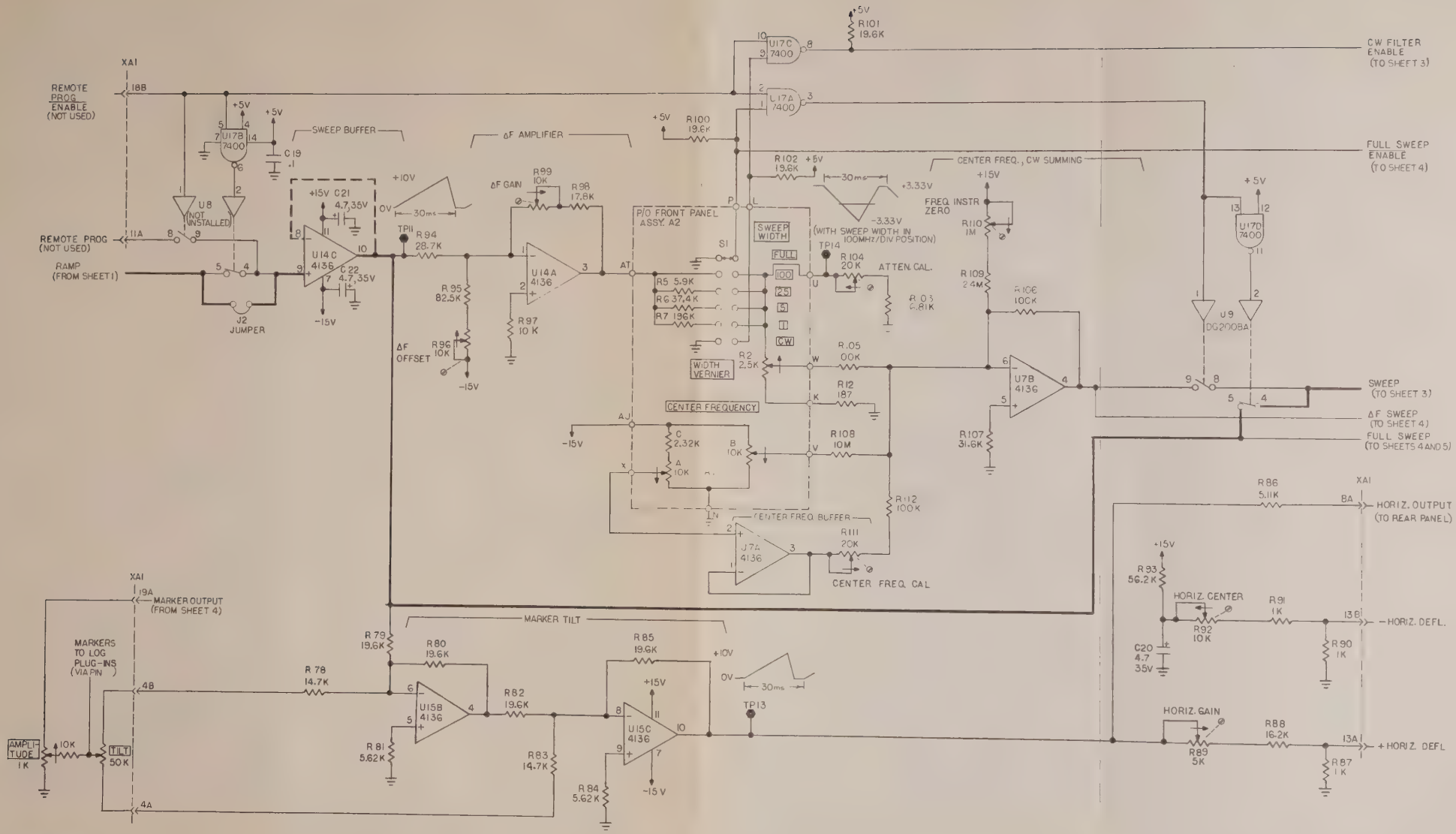


Figure 6-7 Sweep Generator Plug-In, Frequency Instruction (640G-A1/2)

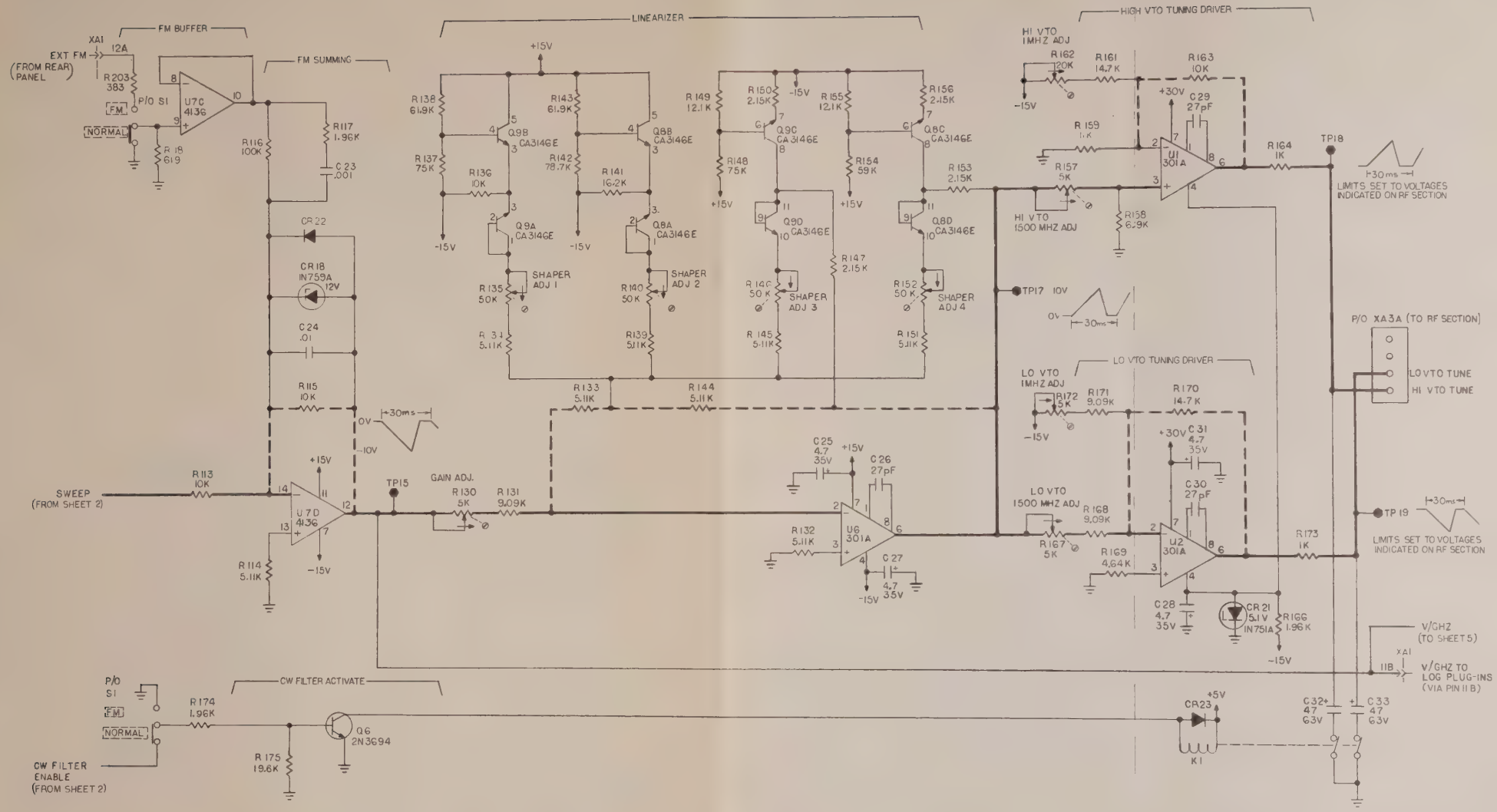


Figure 6-8 Sweep Generator Plug-In, Linearizer (640G-A1/3)

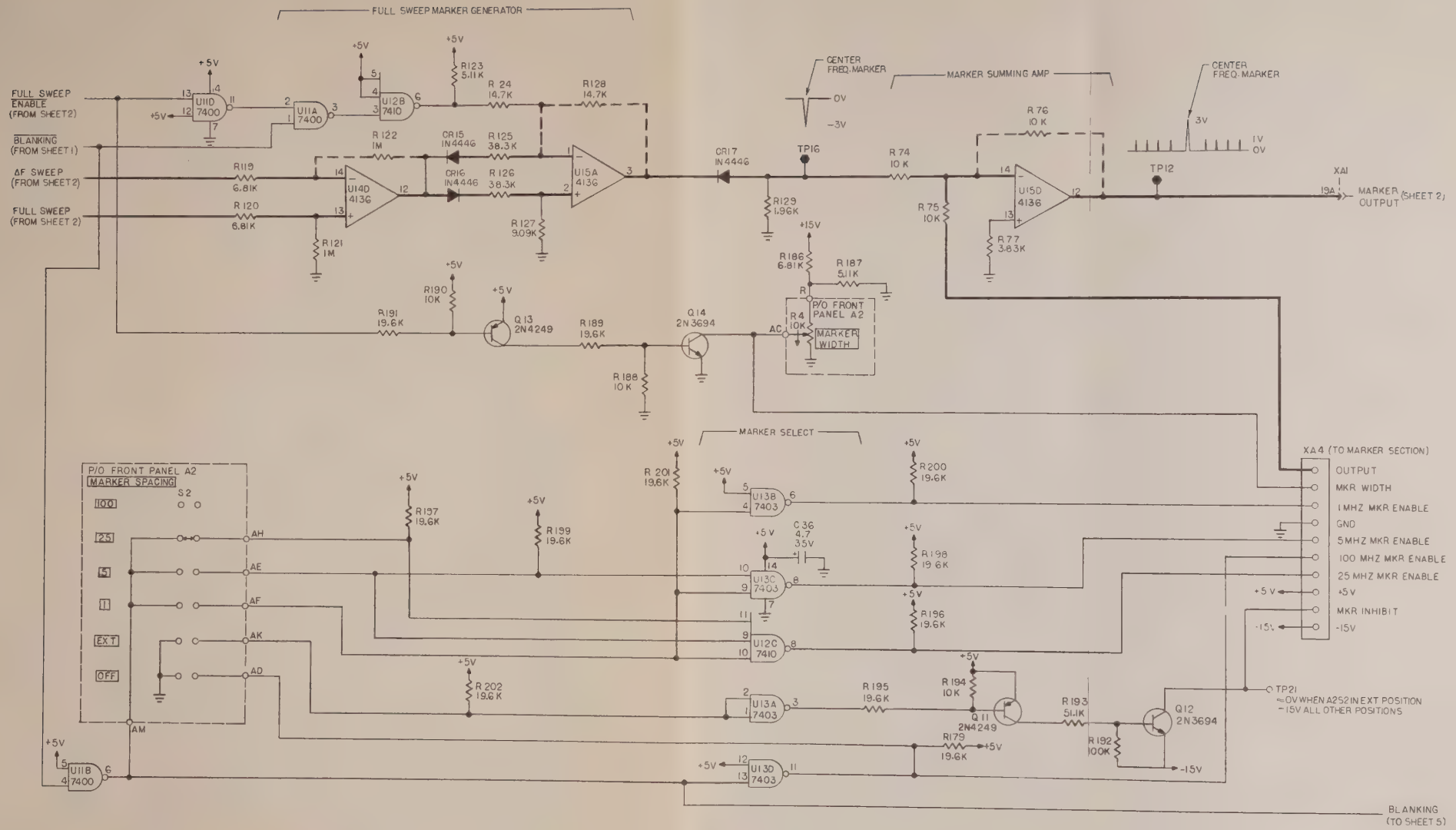


Figure 6-9 Sweep Generator Plug-In, Marker Control (640G-A1/4)

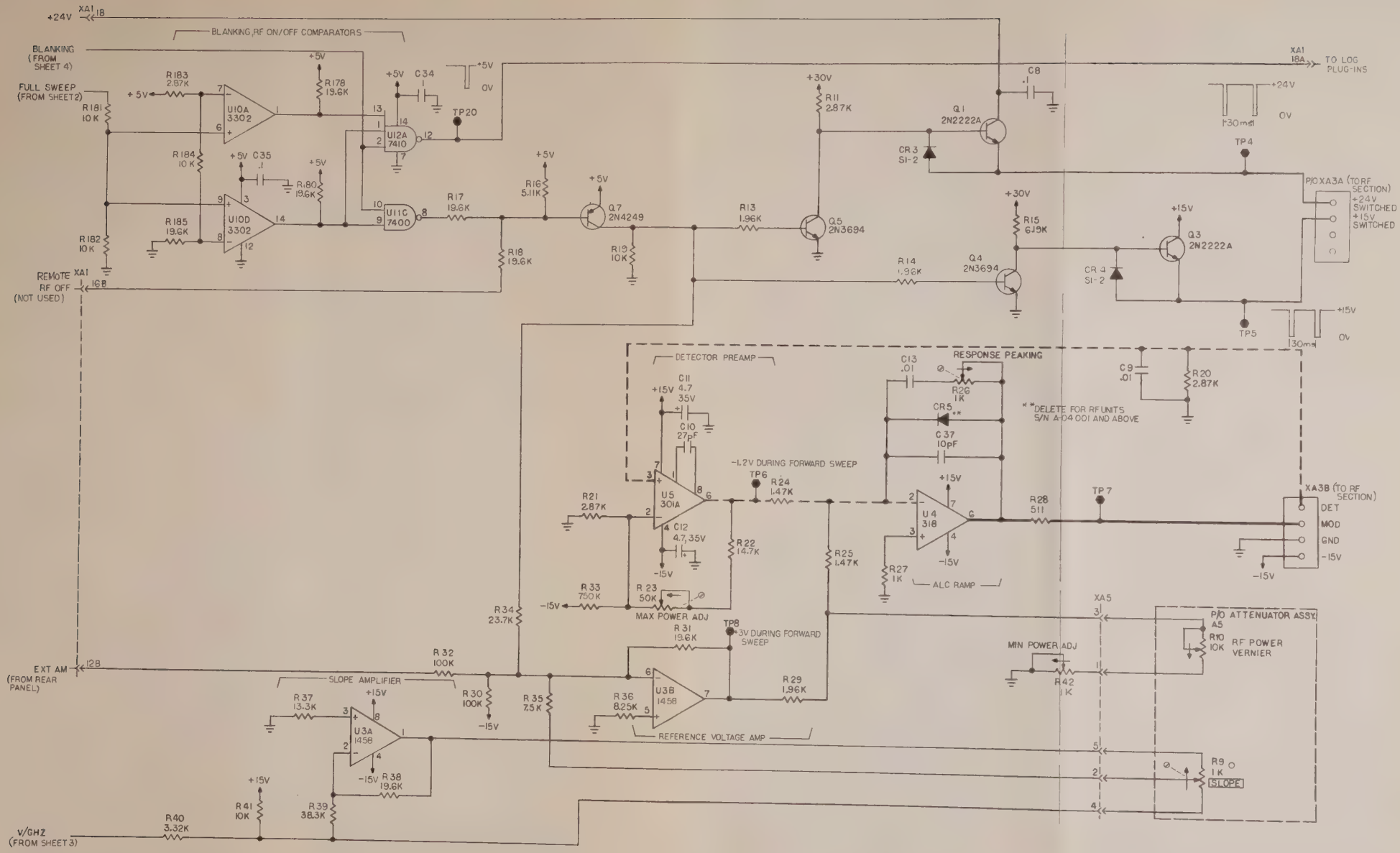


Figure 6-10 Sweep Generator Plug-In, ALC (640G-A1/5)

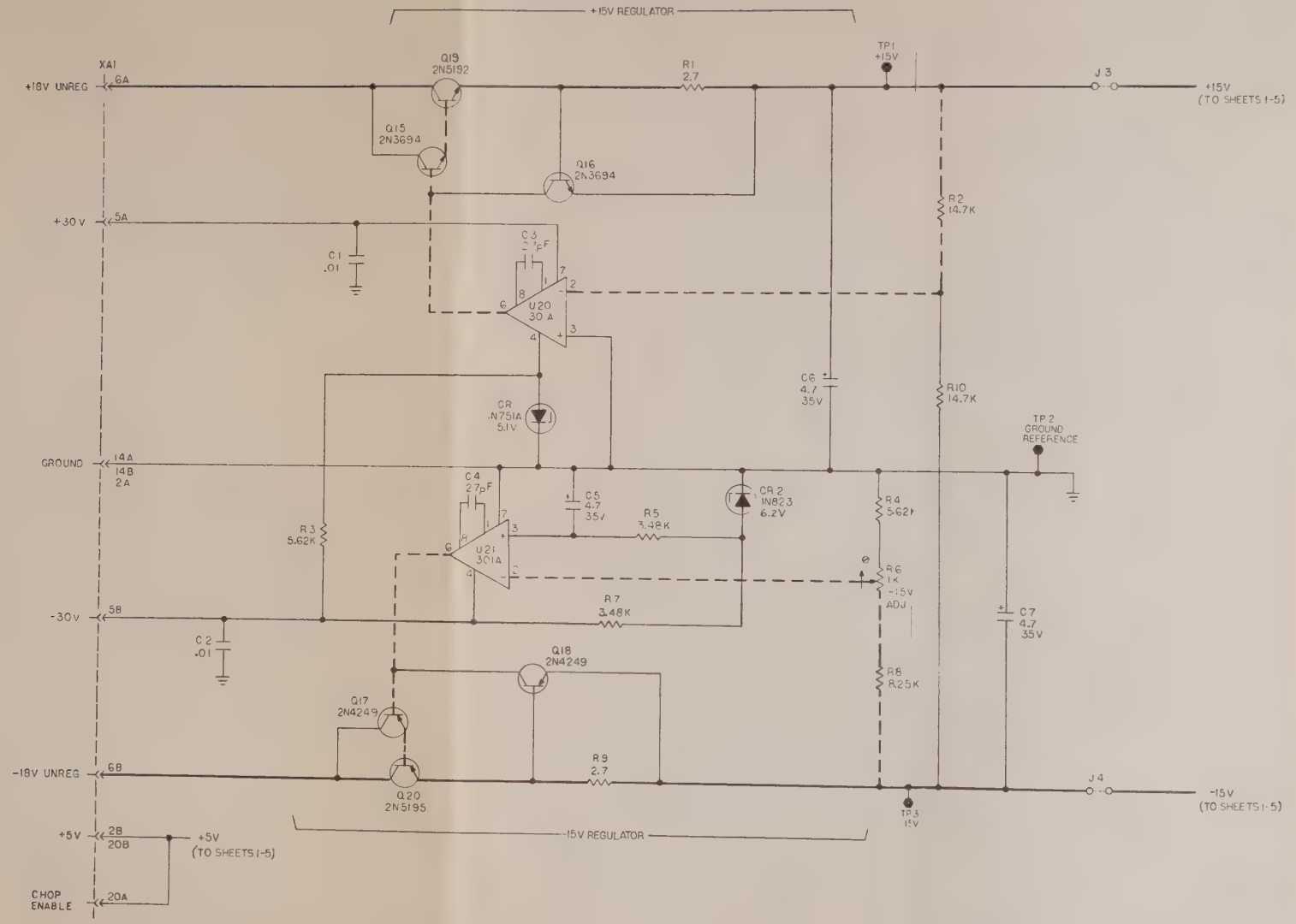


Figure 6-11 Sweep Generator Plug-In, ± 15 V Regulators (640G-A1/6)

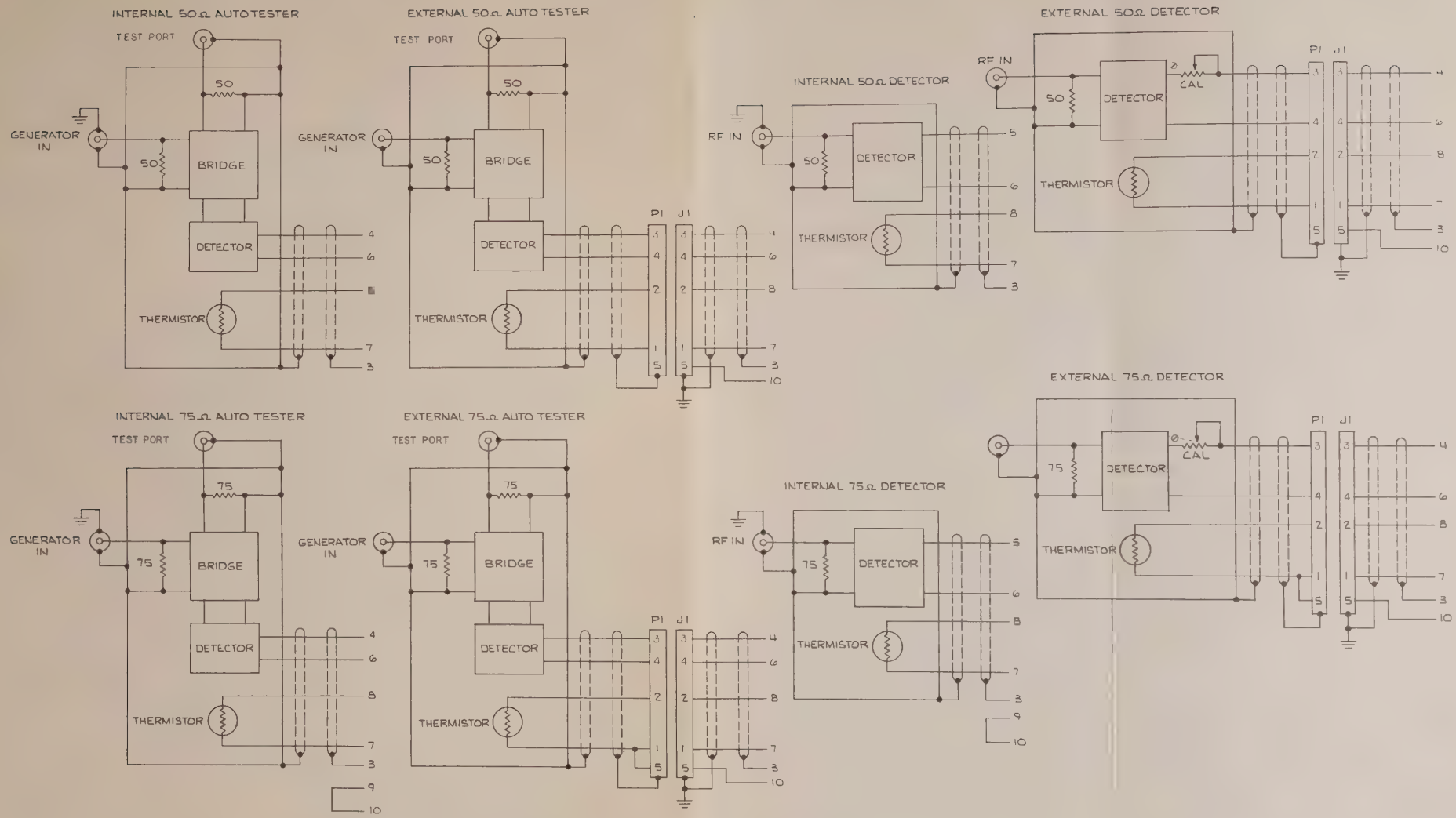
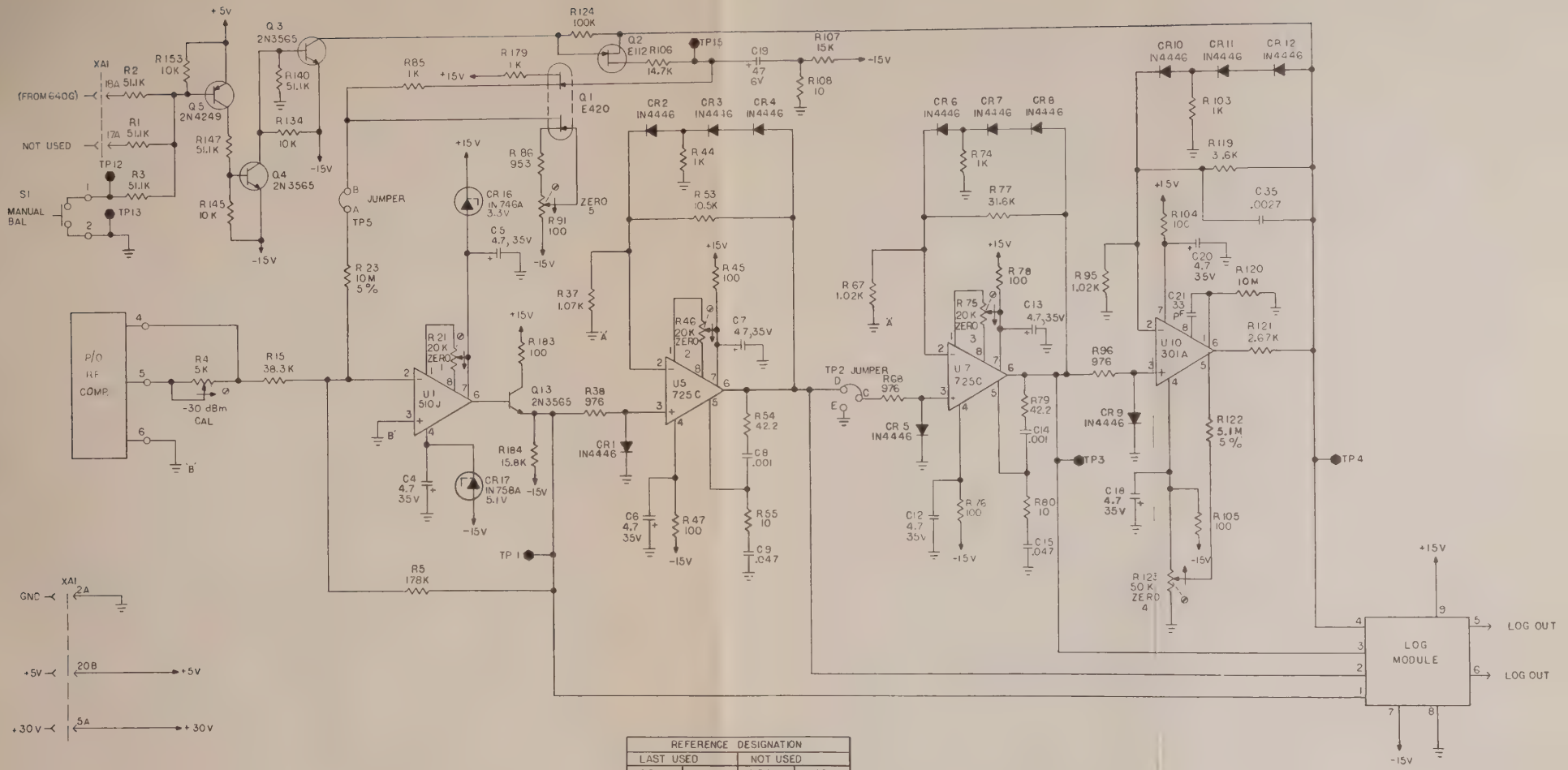


Figure 6-12 Log. Plug-In, RF Components
(640T, R, E-A1/4)



REFERENCE DESIGNATION			
LAST USED		NOT USED	
C37		C34	R69
CR17		R6	R94
R187		R20	R171
S6		R22	
TP18		R111	
U15		R131	
Q13		R137	
		R152	

Figure 6-13. Log. Plug-In, Preamplifier (640T, R, E-A1/1)

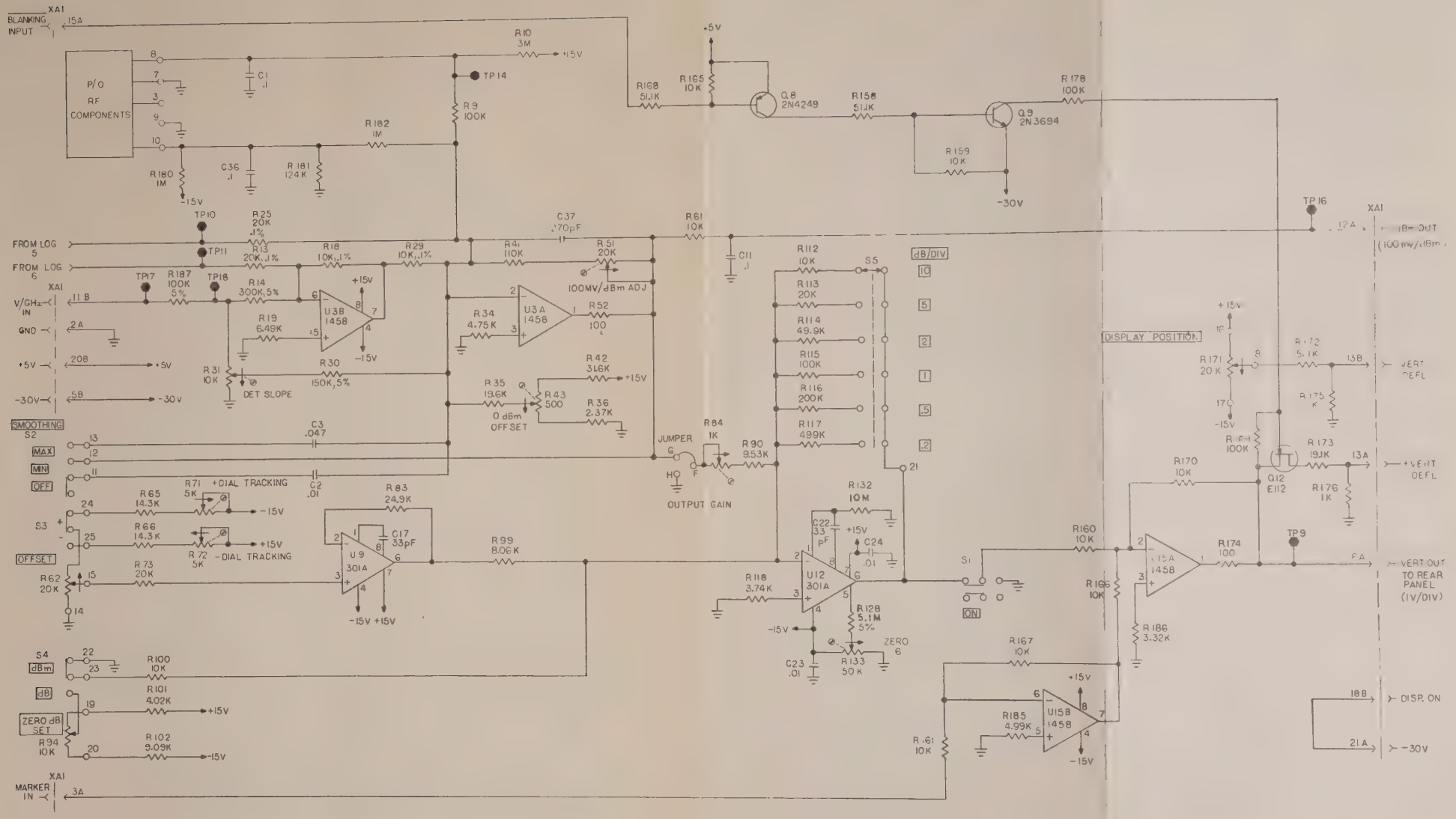


Figure 6-14. Log. Plug-In, Processor (640T, R, E-A1/2)

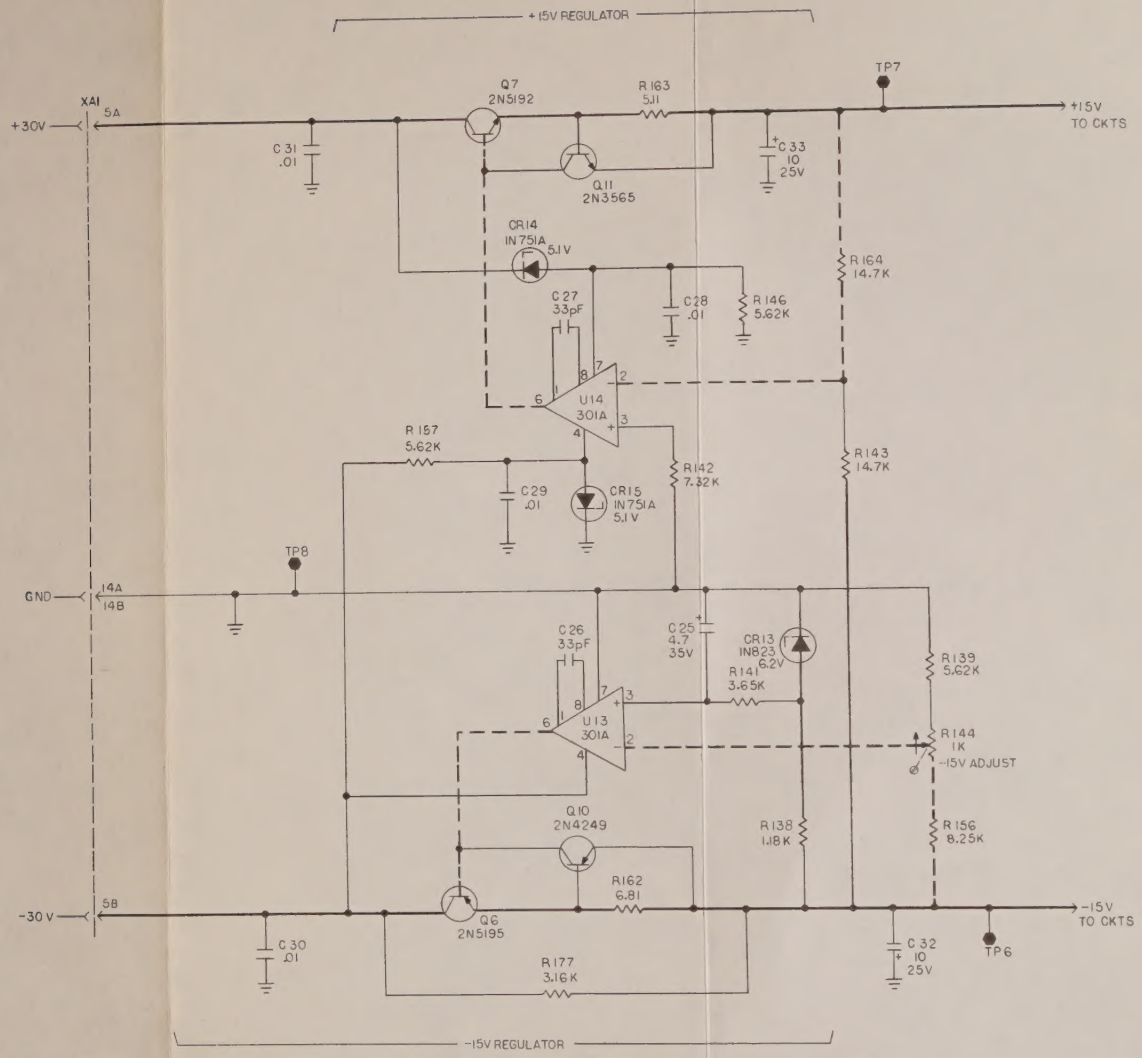


Figure 6-15 Log. Plug-In, ± 15 V Regulators
(640T, R, E-A1/3)

6-31/6-32

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